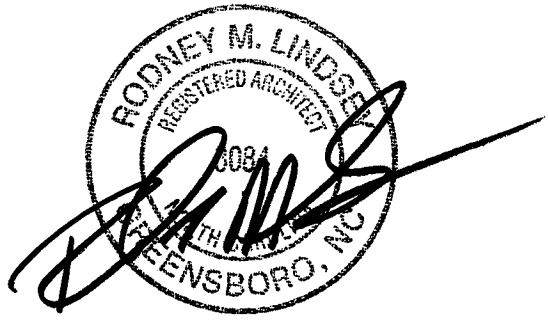
PIEDMONT TRIAD AIRPORT AUTHORITY

SPECIFICATIONS AND
BID DOCUMENT FOR

PTIA Ticket Counter Ceiling Renovation
Piedmont Triad International Airport

Greensboro, North Carolina



LINDSEY ARCHITECTURE
125 S. Elm Street, Suite 300, Greensboro, NC 27401
336.617.4402 Fax 336.617.4434

January 14, 2013
Project No.: 12-040-000

Piedmont Triad International Airport
Ticket Counter Ceiling Renovation

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SECTION 00020 - INVITATION TO BID

To All Interested Parties: The Piedmont Triad Airport Authority, 1000 A Ted Johnson Parkway, Greensboro, North Carolina 27409, will receive sealed bids in the Stanley Frank Board Room at the Piedmont Triad International Airport for furnishing labor and materials for construction of:

PTIA Ticket Counter Ceiling Renovation
Piedmont Triad International Airport
Greensboro, North Carolina

Bidding Requirements:

Bids will be received for construction of the project as follows:

SINGLE PRIME CONTRACT

Bids will be received up until 2:00 p.m., local time, Thursday, February 7, 2013, and at that time publicly opened and read aloud.

Bidders may inspect the applicable bidding requirements and the drawings, specifications, and other contract documents at the office of the Airport Authority, Piedmont Triad International Airport, 1000 A Ted Johnson Parkway, Greensboro, North Carolina, or at the office of Lindsey Architecture, 125 South Elm St., Greensboro, North Carolina.

Bidding documents may be obtained from the office of Lindsey Architecture as follows:

Purchase Price: Make checks payable to Lindsey Architecture.

Complete sets of Drawings and Specifications: $25.00 per set.

Requests for documents shall include the name of the firm, and shall include a phone number, fax number, mailing address, and contact person.

Proposals: Each proposal shall be accompanied by a cash deposit, or a cashier's check, or certified check drawn on some bank or trust company, insured by the Federal Deposit Insurance Corporation, of an amount equal to not less than five percent (5%) of the proposal, or in lieu thereof a bidder may offer a bid bond of five percent (5%) of the bid executed by a surety company licensed under the laws of North Carolina to execute the contract in accordance with the bid bond. Said deposit shall be retained by the Owner as liquidated damages in event of failure of the successful bidder to execute the contract within ten days after the award or to give satisfactory surety as required by law.

A Performance Bond and a Payment Bond will be required for one hundred percent (100%) of the contract price.

Payment will be made on the basis of ninety-five percent (95%) of monthly estimates and final payment made upon completion and acceptance of work.

A Pre-bid Conference will be held Thursday, January 24, 2013 at 2:00 p.m. at the Piedmont Triad Airport Authority office in the Stanley Frank Board Room. All bidders are strongly required to attend. A tour of the project site will be conducted after this conference.

No proposal may be withdrawn after the scheduled closing time for the receipt of bids for a period of 90 days.

Contractor will be given notice to proceed after Owners review of bids and should complete construction ready for Owner occupancy not later than 120 calendar days after the date of the Notice to Proceed.

This project does not have any direct goals for HUB's/DBEs attached to this project, it is the policy of the Piedmont Triad Airport Authority (the Owner) that Disadvantaged Business Enterprises shall have the opportunity to participate in the performance of contracts financed in whole or in part by the Owner in order to maximize opportunities for women and minority-owned businesses in Airport Authority projects.

By submitting a bid under this solicitation, except for those listed by the Bidder in a clearly identified attachment to the bid, the bidder certifies that steel and each manufactured product, is produced in the United States (as defined in the clause Buy American - Steel and Manufactured Products for Construction Contracts) and that components of unknown origin are considered to have been produced or manufactured outside the United States.

By submitting a bid under this solicitation, the bidder certifies to have reviewed all documents in reference to the Contract, General Conditions, Modifications to General Conditions, Supplementary Conditions, Specification Sections, Drawings, addenda and modifications to the Contract Documents issued subsequent to the initial printing of this project manual and including but not necessarily limited to printed material referenced by any of these documents so to complete the work as indicated in the documents.

The bidders must be properly licensed under Chapter 87, General Statues of North Carolina (G.S. 87-15)

The bidders shall certify, by submission of a proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency or the State of North Carolina.

All bids must be made on the appropriate Bid Form. Each proposal submitted shall be placed in a sealed envelope marked:

PTIA Ticket Counter Ceiling Renovation
Piedmont Triad International Airport
Greensboro, North Carolina

and delivered to the Airport Authority's office at the Piedmont Triad International Airport, 1000 A Ted Johnson Parkway, Greensboro, North Carolina.

The owner reserves the right to accept or reject any bid, to reject all bids and re-advertise, or to reject all bids without further action, whatever appears to be in the best interest of the Project.

END OF SECTION 00020

SECTION 00100-INSTRUCTIONS TO BIDDERS

1. Bidder is an individual, firm or corporation submitting a Bid to the Owner for the items contemplated.

2. Sealed Bids will be received at a time and place designated in the INVITATION TO BID.

3. The successful Contractor will be required to obtain any and all necessary licenses or permits to conduct the work within their contract as may be prescribed by the State of North Carolina.

4. Costs of building and utility permits, fees, capacity usage fees, impact fees, or any other fees for inspections required by all City, County, and/or State authorities; all Local, State, and Federal Taxes; and, all other fees and taxes for which the Contractor is liable due to the work on this project shall be included in the Contractor's lump sum bid.

5. The contractor shall be responsible for any and all fines that are assessed for lack of compliance to codes, laws, or any requirements of government agencies.

6. The term "Successful Bidder" means the lowest, qualified, responsible, responsive, BIDDER to whom OWNER (on the basis of OWNER's evaluation as hereinafter provided) makes an award.

7. OWNER and ARCHITECT in making copies of the Bidding Documents available on the above terms do so only for the purpose of obtaining bids on the Work and do not confer a license or grant for any other use.

8. Substitute or "Or-Equal" Material and Equipment: The materials, product and equipment described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by proposed substitution. No substitution will be considered prior to receipt of Bids unless the Architect has received substitutions that must have written documentation proving that it meets or exceeds all aspects of the "basis of design" and shall include a "strike-off" of actual fiber, style, color, weight, and backing before January 24, 2013. Such requests shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitution including drawings, performance and test data, and other information necessary for an evaluation. A statement setting forth changes in other materials, equipment or other portions of the work including changes in the work of other contracts that incorporation of the proposed substitution would require shall be included. The burden of proof of the merit of the proposed substitution is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final. If the Architect approved a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approvals made in any other manner. No substitutions will be approved after award of the contract unless specifically provided for in the contract documents.

9. Bid Form: Bids shall be submitted on the form furnished herein. A loose copy of Bid Form can be provided if requested for submitting Bid. All blank spaces shall be filled in correctly for each and every item for which a price or information is requested. The Bidder shall state the price, typewritten or written in ink, both in words and numerals, for each item.

10. Signature on Bid: The Bidder must sign the bid correctly. If made by an individual, his or her name and post office address shall be shown. If made by a firm or partnership, the name and post office address of each member of the firm or partnership shall be shown. If made by a corporation, the person signing the Bid shall show the name of the state under the laws of which the corporation was chartered, and the name and business address of its president, secretary and treasurer. The Bid shall bear the seal of the corporation attested by the secretary. Anyone signing the Bid as agent shall file with the Bid legal evidence of the authority to do so.

11. Familiarity with Laws: The Bidder is assumed to be familiar with all federal, state and local laws, ordinances, rules and regulations that in any manner affect bidding and performance. The Bidder will not be relieved of responsibility due to ignorance of the law.

12. Addenda: All addenda issued by the Owner prior to the opening of Bids for the purpose of changing the specifications, or clarifying the meaning of same, shall be binding in the same way as if written in the specifications. All addenda are available to Bidders at the office of the Owner, and it is each Bidder's responsibility to check with the issuing office and immediately secure all addenda before submitting a Bid. It is the usual practice for the Owner to mail addenda to known Bidders, but it cannot be guaranteed that all Bidders will receive addenda in this manner. Each Bidder shall acknowledge receipt of the addenda by notation in the space provided on the Bid Form.

13. Examination of Drawings and Specifications: The Bidder is required, before submitting a bid, to become familiar with the nature and extent of the work, any local conditions that may affect the work, and the equipment, materials and labor required. The bidder is also required to examine carefully the drawings, specifications, the Form of Agreement, the Bid Guaranty, insurance requirements, and to become accurately informed of conditions and requirements contained herein that may affect the work to be performed. Neither the Architect-Engineer nor Owner will assume any responsibility for bidding errors and omissions caused by failure of the Contractor or any subcontractor to fully comply with these requirements. Complete sets of drawings, specification, and other contract documents related to this contract are available for inspection.

14 The submission of a BID will constitute an incontrovertible representation by BIDDER that BIDDER has complied with every requirement of this article, and the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance and furnishing of the documents.

15 Two (2) sets of the following original, signed, documents shall be included within the envelope submitted by the bidder:

i. The Bid Form, including all affidavits and sub sections of the Bid Form.

16. Right to Reject Bid: Right is reserved to reject any or all Bids and to waive any informality or irregularity in any Bid received.

17. Award of Contract: The award of the contract, if it is awarded, will be to the lowest responsible, responsive Bidder Bid Proposal complies with the requirements of the Contract Documents. In no case will the award be made until all necessary investigations have been made to determine the qualifications of the low bidder. To demonstrate qualifications to perform the work, the contractor submitting the lowest responsive bid must submit, within seven (7) days of Bid Opening, evidence which may be required by the owner, such as, but not limited to, financial data and previous experience. Each responsive bid by the contract must contain evidence of the Bidder’s qualifications to do business in the state where the project is located. Conditional or qualified Bids by the contractor will not be accepted.

18. Execution of the Agreement: The individual, firm or corporation to which the contract has been awarded shall sign the Agreement entering into contract with the Owner, and return it to the Owner within ten days from the date of award. No contract shall be considered binding upon the Owner until it has been properly executed. The agreement shall be executed on the contract form included herein.

19. Withdrawal of Bids: Bids may be withdrawn by written communication with the Owner, without prejudice to the Bidder no later than the day and hour set for opening Bids. The Bid will be returned unopened.

20. Intent of the Drawings and Specifications: If contradictions occur within the specifications or drawings concerning quantity, quality or method of installation, the Bidder shall include the cost of furnishing the more expensive item or installation, and the greater quantity.

21. The bid documents are not to be scaled or used to determine any quantities.

22. Contractor is responsible for providing protection of all existing finishes, equipment, and anything that is within the project scope area.

23. All work can be done between the hours of 8:00 p.m. and 4:00 a.m.

24. Contractor is responsible to repair any and all damage that is done by the contractor or their subs during construction.

25. Inquiries: All inquiries in regard to the Contract Documents during the bid period shall be directed to:

Lindsey Architecture, p.c.
125 S. Elm Street, Suite 300
Greensboro, North Carolina 27401
(336) 617-4402
(336) 617-4434 fax
Attention: Rod Lindsey, AIA
Re: PTIA Ticket Counter Ceiling Renovation
Piedmont Triad International Airport

END OF SECTION 00100

SECTION 00310-BID FORM FOR GENERAL CONSTRUCTION

TO BE SUBMITTED IN DUPLICATE

FOR GENERAL CONSTRUCTION WORK:

PTIA Ticket Counter Ceiling Renovation

Piedmont Triad International Airport
Greensboro, North Carolina 27409

PIEDMONT TRIAD AIRPORT AUTHORITY

AEP File No. 12-001-000

Date of Bid: _____

Name of Bidder: _____

Address: _____

City, State and Zip Code: _____

Phone Number: _____

TO: **PIEDMONT TRIAD AIRPORT AUTHORITY**
Attn: Mr. J. Alex Rosser, P.E., Director of Planning and Engineering
1000 A Ted Johnson Parkway
Greensboro, NC 27409

The Undersigned has received and reviewed a complete set of the Bid Documents and Bidding Requirements for the Project titled:

PTIA Ticket Counter Ceiling Renovation
PIEDMONT TRIAD INTERNATIONAL AIRPORT
GREENSBORO, N.C. 27409

Including the Addenda specified below, and in submitting this Bid agree to the following:

1. The undersigned, hereinafter called Bidder, in response to the Invitation to Bid, accepting all of the terms and conditions of the "Instructions to Bidders", proposes and agrees, if awarded the Contract, to enter into an Agreement with the Owner, upon notice of such award, in the form of Agreement included in the Bid Documents, to furnish all materials, equipment, machinery, tools, apparatus, means of transportation and labor necessary to complete the work to be performed under this Contract, in full and complete accordance with the shown, noted, described and reasonably intended requirements of the Contract Documents, to the full and entire satisfaction of the Owner, for the amounts contained in the Bid Schedules.

2. This Bid will remain open for 90 days after the day of Bid opening. If awarded a contract, Bidder will sign the Agreement.

3. In submitting this Bid, Bidder represents that:

   a. Bidder has become thoroughly familiar with the terms and conditions of the proposed Contract Documents accepting the same as sufficient to indicate understanding of all the conditions and requirements under the Contract which will be executed for the Work.

   b. Bidder has examined the site and locality where the Work is to be performed, the legal requirements (Federal, state, and local laws, ordinances, rules, and regulations) and the conditions affecting cost, progress, or performance of the Work, and has made such independent investigations as Bidder deems necessary.

   c. This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for himself any advantage over any other Bidder or over Owner.

   d. That no member of the Authority or other officers or employees of said Owner is interested directly or indirectly in the Bid or in any portion of the Bid nor in the Contract or any part of the Contract which may be awarded the undersigned on the basis of such Bid.

   e. It is a condition of this Bid and any subsequent contract entered into pursuant to this Bid, and it shall be made a condition of each subcontract entered into pursuant to the prime contract that the Contractor and any Subcontractor shall not require any laborer or mechanic employed in performance of the contract to work in surroundings or under working conditions which are unsatisfactory, hazardous, or dangerous to his health or safety, as determined under Construction Safety and Health Standards, Title 29, CFR, Part 1518 36FR7340, promulgated by the U.S. Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act, 82, Statt. 96; that it is a further condition of this Bid that he shall be solely responsible for the enforcement of such Construction and Health Standards, and that he definitely understands that the Owner and his authorized representatives will not assume any liability resulting from his failure to police and enforce all such standards.

   f. The description under each bid item, being briefly stated, implies, although it does not mention, all incidentals and that the prices stated are intended to cover all such work, materials and incidentals as constitute Bidder's obligations as described in the Bid Documents, and any details not specifically mentioned, but evidently included in the Contract shall be compensated for in the item which most logically includes it.

4. Contract Time: Bidder agrees that:

   a. The work will be installed prior to sixty (120) calendar days from the notice to proceed that will be issued by the Owner.

b. The bidder will commence work with an adequate force and equipment at the time stated in the Notice to Proceed, and complete all work in the number of days stipulated from the date stated in said notice including working overtime or on Saturdays, Sundays, or legal holidays except as specifically allowed by the Contract Documents and approved by the Owner.

5. Bids shall include all sales tax and other applicable taxes and fees.

6. Name and business address (mailing and street) of Bidder to which all formal notices shall be sent:

_____

_____

7. Execution of Contract: Bidder agrees that in case of failure on his part to execute the said Contract and Bonds within two (2) days after the date indicated in the "Notice of Award", the check or bid bond accompanying this Bid, and the money payable thereon, shall be paid to the OWNER as liquidated damages for such failure; otherwise the Bid Bond or check accompanying this Bid shall be returned to the undersigned.

8. Bid Documentation: The following documents are attached to and made a part of this Bid:
   a. Non-collusion Affidavit
   b. EEO Report Statement
   c. Certificate of Nonsegregated Facilities
   d. Performance of Work by Subcontractors
   e. Certification Regarding Fair Trade
   f. Buy American Certification
   g. Certification Regarding Debarment, Suspension, Ineligibility, and Voluntary Exclusion
   h. Certificate of Prompt Payment
   i. Required Bid Security in the form of a Bid Bond payable to the order of the Piedmont Triad Airport Authority

9. The terms used in this Bid which are defined in the General Provisions of the Contract for Furniture, Furnishings, and Equipment (AIA A251) included as a part of the Contract Documents have the meanings assigned to them in the General Provisions.

10. Bidder hereby acknowledges receipt of the following addenda:

Addendum No. _____ Date_____

Addendum No. _____ Date_____

Addendum No. _____ Date_____

1. LUMP SUM BASE BID

Proposed lump sum price for the work complete and acceptable:

_____Dollars ($ _____)

Respectfully submitted on _____day of _____, 2013.

Bidder_____

Address_____

(Corporate Seal)

_____

Signed: _____

Witness: _____

Individual trading in own name_____

Individual trading under firm name _____

Co-partners trading under firm name _____

Corporation - State of _____,

President _____

(Name)

(Address)

Secretary _____

Treasurer _____

END OF SECTION 00310

(This Affidavit is Part of Bid)

FORM OF NONCOLLUSION AFFIDAVIT

STATE OF)
)SS.
COUNTY OF)

being first duly sworn, deposes and says that he is _____
(Sole owner, a partner, president, secretary, etc.)

of _____
the party making the foregoing Proposal or BID that such BID is genuine and not collusive or sham; that said BIDDER has not colluded, conspired, connived, or agreed, directly or indirectly, with any BIDDER or person, to put in a sham BID, or that such other person shall refrain from bidding, and has not in any manner, directly or indirectly sought by agreement or collusion, or communication or conference, with any person, to fix the Bid Price of affiant or any other BIDDER, or to fix any overhead, profit or cost element of said Bid Price, or of that of any other BIDDER, or to secure any advantage against OWNER any person interested in the proposed Contract; and that all statements in said Proposal or Bid are true; and further, that such BIDDER has not, directly or indirectly submitted this BID, or the contents thereof, or divulged information or date relative thereto to any association or to any member or agent thereof.

_____

(Bidder)

Sworn to and subscribed before me this _____ day of _____ , 20_____.

Notary Public in and for _____
(County)

: My Commission expires _____ 20 ___.
(SEAL)

(This Affidavit is Part of Bid)

EQUAL OPPORTUNITY REPORT STATEMENT
AS REQUIRED BY 41 CFR 60-1.7(b)

The Bidder (Proposer) shall complete the following statement by checking the appropriate blanks. Failure to complete these blanks may be grounds for rejection of bid:

1. The Bidder (Proposer) has _____ has not _____ developed and has on file at each establishment affirmative action programs pursuant to 41 CFR 60-1.40 and 41 CFR 60-2.

2. The Bidder (Proposer) has _____ has not _____ participated in any previous contract or subcontract subject to the equal opportunity clause prescribed by Executive Order 11246, as amended.

3. The Bidder (Proposer) has _____ has not _____ filed with the Joint Reporting Committee the annual compliance report on Standard Form 100 (EEO-1 Report).

4. The Bidder (Proposer) does _____ does not _____ employ fifty (50) or more employees.

NAME OF BIDDER: _____

BY: _____

TITLE: _____

DATE: _____

(This Affidavit is Part of Bid)

SUBCONTRACTS EXCEEDING $10,000 WHICH ARE NOT
EXEMPT FROM THE EQUAL OPPORTUNITY CLAUSE

CERTIFICATION OF NONSEGREGATED FACILITIES

The federally assisted construction contractor certifies that he does not maintain or provide, for his employees, any segregated facilities at any of his establishments and that he does not permit his employees to perform their services at any location under his control where segregated facilities are maintained. The federally assisted construction contractor certifies that he will not maintain or provide for his employees, segregated facilities at any of his establishments and that he will not permit his employees to perform their services at any location under his control where segregated facilities are maintained. The federally assisted construction contractor agrees that a breach of this certification is a violation of the equal opportunity clause in this contract.

As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, timeclocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directives or are in fact segregated on the basis of race, color, religion or national origin because of habit, local custom, or any other reason. The federally assisted construction contractor agrees that (except where he has obtained identical certifications from proposed subcontractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding $10,000 which are not exempt from the provisions of the equal opportunity clause and that he will retain such certifications in his files.

Certification - The information above is true and complete to the best of my knowledge and belief. (Please Type)

Name and Title of Signer: _____

Signature: _____

Date: _____

Company: _____

Address: _____

_____

Note: The penalty for making false statements in an offer are prescribed in 18 U.S.C. 1001.

(This Affidavit is Part of Bid)

PERFORMANCE OF WORK BY SUBCONTRACTORS

The Bidder hereby states that he proposes, if awarded the Contract, to use the following Subcontractors on this project. List below all proposed Subcontractors and trade specialties. (List only one Subcontractor for each item). The Bidder shall obtain prior written permission of the Owner should he choose to add or substitute other Subcontractor(s) not shown herein.

Items	Subcontractors
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Estimated total cost of items that Bidder states will be performed by Subcontractor:

_____

($ _____).

(This Affidavit is Part of Bid)

CERTIFICATION REGARDING FAIR TRADE

The contractor or subcontractor, by submission of an offer and/or execution of a contract, certified that it:

A. is not owned or controlled by one or more citizens or nationals of a foreign country included in the list of countries that discriminate against U.S. firms published by the Office of the United States Trade Representative (USTR);

B. has not knowingly entered into any contract or subcontract for this project with a contractor that is a citizen or national of a foreign country on said list, or is owned or controlled directly or indirectly by one or more citizens or nationals of a foreign country on said list; and

C. has not procured any product nor subcontracted for the supply of any product for use on the project that is produced in a foreign country on said list.

Unless the restrictions of this clause are waived by the Secretary of Transportation in accordance with 49 CFR 30.17, no contract shall be awarded to a contractor or subcontractor who is unable to certify to the above. If the contractor knowingly procures or subcontracts for the supply of any product or service of a foreign country on the said list for use on the project, the Federal Aviation Administration may direct, through the sponsor, cancellation of the contract at no cost to the Government.

Further, the contractor agrees that, if awarded a contract resulting from this solicitation, it will incorporate this provision for certification without modification in each contract and in all lower tier subcontracts. The contractor may rely upon the certification of a prospective subcontractor unless it has knowledge that the certification is erroneous.

The contractor shall provide immediate written notice to the sponsor if the contractor learns that its certification or that of a subcontractor was erroneous when submitted or has become erroneous by reason of changed circumstances. The subcontractor agrees to provide immediate written notice to the contractor, if at any time it learns that its certification was erroneous by reason of changed circumstances.

This certification is a material representation of fact upon which reliance was placed when making the award. If it is later determined that the contractor or subcontractor knowingly rendered an erroneous certification, the Federal Aviation Administration may direct, through the sponsor, cancellation of the contract or subcontract for default at no cost to the Government.

Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by this provision. The knowledge and information of a contractor is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

This certification concerns a matter within the jurisdiction of an agency of the United States of America and the making of a false, fictitious, or fraudulent certification may render the maker subject to prosecution under Title 18, United States, Section 1001.

NAME OF BIDDER: _____

BY: _____

TITLE: _____

DATE: _____

(This Affidavit is Part of Bid)

BUY AMERICAN CERTIFICATE

By submitting a bid/proposal the offeror certifies that steel and each manufactured product, is produced in the United States (as defined in the clause Buy American - Steel and Manufactured Products or Buy American - Steel and Manufactured Products For Construction Contracts) and that components of unknown origin are considered to have been produced or manufactured outside the United States.

Any material that is not produced or manufactured in the United States must have been granted a waiver by the Federal Aviation Administration (FAA) PRIOR TO BID. List all waivers below and include a copy along with the bid.

Material and or Manufacturer:

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

NAME OF BIDDER: _____

BY: _____

TITLE: _____

DATE: _____

(This Affidavit is Part of Bid)

CERTIFICATION REGARDING DEBARMENT, SUSPENSION,
INELIGIBILITY, AND VOLUNTARY EXCLUSION

The bidder/offeror certifies, by submission of this proposal or acceptance of this contract, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency. It further agrees by submitting this proposal that it will include this clause without modification in all lower tier transactions, solicitations, proposals, contracts, and subcontracts. Where the bidder/offer/contractor or any lower tier participant is unable to certify to this statement, it shall attach an explanation to this solicitation/proposal.

NAME OF BIDDER: _____

BY: _____

TITLE: _____

DATE: _____

(This Affidavit is Part of Bid)

PROMPT PAYMENT

The prime contractor agrees to pay each subcontractor under this prime contract for satisfactory performance of its contract less agreed retainer no later than seven (7) calendar days from the receipt of each payment the prime contractor receives from the Owner. The prime contractor agrees further to return retainage payments to each subcontractor within seven (7) calendar days after the subcontractor's work is satisfactorily completed. Any delay or postponement of payment from the above referenced time frame may occur only for good cause following written approval of the Owner. This clause applies to both DBE and non-DBE subcontractors.

NAME OF BIDDER: _____

BY: _____

TITLE: _____

DATE: _____

BID SECURITY

SECTION 00500 - AGREEMENT

1.1 AGREEMENT

A. The Standard Form of Agreement between Owner and Contractor, where the basis of payment is a stipulated sum, AIA Document A101, 2007 Edition, forms the basis of the Contract between the Owner and Contractor.

END OF SECTION 00500

DRAFT

AIA® Document A101™ – 2007

Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum

AGREEMENT made as of the « » day of « » in the year « »
(In words, indicate day, month and year.)

BETWEEN the Owner:
(Name, legal status, address and other information)

«Piedmont Triad Airport Authority»« »
«1000A Ted Johnson Parkway
Greensboro, NC 27409»
«Telephone Number: 336.665.5600»
« »

and the Contractor:
(Name, legal status, address and other information)

« »« »
« »
« »
« »

for the following Project:
(Name, location and detailed description)

«PTIA Ticket Counter Ceiling Renovation»
«Piedmont Triad International Airport
1000A Ted Johnson Parkway
Greensboro, NC 27409»
«Renovate the ceilings over the airline ticket counter ceilings
at the Piedmont Triad International Airport»

The Architect:
(Name, legal status, address and other information)

«Lindsey Architecture, p.c.»« »
«125 S. Elm St., Suite 300
Greensboro, NC 27401»
«Telephone Number: 336.617.4402»
«Fax Number: 336.617.4434»

The Owner and Contractor agree as follows.

ADDITIONS AND DELETIONS: The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

AIA Document A201™–2007, General Conditions of the Contract for Construction, is adopted in this document by reference. Do not use with other general conditions unless this document is modified.

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TABLE OF ARTICLES

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ARTICLE 1 THE CONTRACT DOCUMENTS

The Contract Documents consist of this Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of this Agreement, other documents listed in this Agreement and Modifications issued after execution of this Agreement, all of which form the Contract, and are as fully a part of the Contract as if attached to this Agreement or repeated herein. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations or agreements, either written or oral. An enumeration of the Contract Documents, other than a Modification, appears in Article 9.

ARTICLE 2 THE WORK OF THIS CONTRACT

The Contractor shall fully execute the Work described in the Contract Documents, except as specifically indicated in the Contract Documents to be the responsibility of others.

ARTICLE 3 DATE OF COMMENCEMENT AND SUBSTANTIAL COMPLETION

§ 3.1 The date of commencement of the Work shall be the date of this Agreement unless a different date is stated below or provision is made for the date to be fixed in a notice to proceed issued by the Owner.
(Insert the date of commencement if it differs from the date of this Agreement or, if applicable, state that the date will be fixed in a notice to proceed.)

«The commencement date will be fixed in a notice to proceed.»

If, prior to the commencement of the Work, the Owner requires time to file mortgages and other security interests, the Owner's time requirement shall be as follows:

«Not Applicable»

§ 3.2 The Contract Time shall be measured from the date of commencement.

§ 3.3 The Contractor shall achieve Substantial Completion of the entire Work not later than «One hundred sixty» («160») days from the date of commencement, or as follows:
(Insert number of calendar days. Alternatively, a calendar date may be used when coordinated with the date of commencement. If appropriate, insert requirements for earlier Substantial Completion of certain portions of the Work.)

« »

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Portion of Work	Substantial Completion Date

, subject to adjustments of this Contract Time as provided in the Contract Documents.
(Insert provisions, if any, for liquidated damages relating to failure to achieve Substantial Completion on time or for bonus payments for early completion of the Work.)

«$1,000 per day as indicated in specification section 00800 Supplementary Conditions»

ARTICLE 4 CONTRACT SUM

§ 4.1 The Owner shall pay the Contractor the Contract Sum in current funds for the Contractor's performance of the Contract. The Contract Sum shall be « » ($ « »), subject to additions and deductions as provided in the Contract Documents.

§ 4.2 The Contract Sum is based upon the following alternates, if any, which are described in the Contract Documents and are hereby accepted by the Owner:
(State the numbers or other identification of accepted alternates. If the bidding or proposal documents permit the Owner to accept other alternates subsequent to the execution of this Agreement, attach a schedule of such other alternates showing the amount for each and the date when that amount expires.)

« »

§ 4.3 Unit prices, if any:
(Identify and state the unit price; state quantity limitations, if any, to which the unit price will be applicable.)

Item	Units and Limitations	Price Per Unit ($0.00)

§ 4.4 Allowances included in the Contract Sum, if any:
(Identify allowance and state exclusions, if any, from the allowance price.)

Item	Price

ARTICLE 5 PAYMENTS

§ 5.1 PROGRESS PAYMENTS

§ 5.1.1 Based upon Applications for Payment submitted to the Architect by the Contractor and Certificates for Payment issued by the Architect, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

§ 5.1.2 The period covered by each Application for Payment shall be one calendar month ending on the last day of the month, or as follows:

« »

§ 5.1.3 Provided that an Application for Payment is received by the Architect not later than the «23rd Day of the Month» day of a month, the Owner shall make payment of the certified amount to the Contractor not later than the «twenty-fifth (25th)» day of the «following» month. If an Application for Payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than «Forty-five» («45») days after the Architect receives the Application for Payment.
(Federal, state or local laws may require payment within a certain period of time.)

§ 5.1.4 Each Application for Payment shall be based on the most recent schedule of values submitted by the Contractor in accordance with the Contract Documents. The schedule of values shall allocate the entire Contract Sum among the various portions of the Work. The schedule of values shall be prepared in such form and supported

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by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment.

§ 5.1.5 Applications for Payment shall show the percentage of completion of each portion of the Work as of the end of the period covered by the Application for Payment.

§ 5.1.6 Subject to other provisions of the Contract Documents, the amount of each progress payment shall be computed as follows:

.1 Take that portion of the Contract Sum properly allocable to completed Work as determined by multiplying the percentage completion of each portion of the Work by the share of the Contract Sum allocated to that portion of the Work in the schedule of values, less retainage of «Five» percent («5.00» %). Pending final determination of cost to the Owner of changes in the Work, amounts not in dispute shall be included as provided in Section 7.3.9 of AIA Document A201™–2007, General Conditions of the Contract for Construction;

.2 Add that portion of the Contract Sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off the site at a location agreed upon in writing), less retainage of «Five» percent («5.00» %);

.3 Subtract the aggregate of previous payments made by the Owner; and

.4 Subtract amounts, if any, for which the Architect has withheld or nullified a Certificate for Payment as provided in Section 9.5 of AIA Document A201–2007.

§ 5.1.7 The progress payment amount determined in accordance with Section 5.1.6 shall be further modified under the following circumstances:

.1 Add, upon Substantial Completion of the Work, a sum sufficient to increase the total payments to the full amount of the Contract Sum, less such amounts as the Architect shall determine for incomplete Work, retainage applicable to such work and unsettled claims; and
(Section 9.8.5 of AIA Document A201–2007 requires release of applicable retainage upon Substantial Completion of Work with consent of surety, if any.)

.2 Add, if final completion of the Work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Section 9.10.3 of AIA Document A201–2007.

§ 5.1.8 Reduction or limitation of retainage, if any, shall be as follows:
(If it is intended, prior to Substantial Completion of the entire Work, to reduce or limit the retainage resulting from the percentages inserted in Sections 5.1.6.1 and 5.1.6.2 above, and this is not explained elsewhere in the Contract Documents, insert here provisions for such reduction or limitation.)

«Retainage may be reduced to 2.5% at 50% completion, if in the architect's opinion, the work is progressing in a timely manor and AIA Document G707A is submitted.»

§ 5.1.9 Except with the Owner's prior approval, the Contractor shall not make advance payments to suppliers for materials or equipment which have not been delivered and stored at the site.

§ 5.2 FINAL PAYMENT

§ 5.2.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be made by the Owner to the Contractor when

.1 the Contractor has fully performed the Contract except for the Contractor's responsibility to correct Work as provided in Section 12.2.2 of AIA Document A201–2007, and to satisfy other requirements, if any, which extend beyond final payment; and

.2 a final Certificate for Payment has been issued by the Architect.

§ 5.2.2 The Owner's final payment to the Contractor shall be made no later than 30 days after the issuance of the Architect's final Certificate for Payment, or as follows:

«thirty (30) days after the final payment is reviewed by the Airport Authority Board»

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ARTICLE 6 DISPUTE RESOLUTION

§ 6.1 INITIAL DECISION MAKER

The Architect will serve as Initial Decision Maker pursuant to Section 15.2 of AIA Document A201–2007, unless the parties appoint below another individual, not a party to this Agreement, to serve as Initial Decision Maker.
(If the parties mutually agree, insert the name, address and other contact information of the Initial Decision Maker, if other than the Architect.)

« »
« »
« »
« »

§ 6.2 BINDING DISPUTE RESOLUTION

For any Claim subject to, but not resolved by, mediation pursuant to Section 15.3 of AIA Document A201–2007, the method of binding dispute resolution shall be as follows:
(Check the appropriate box. If the Owner and Contractor do not select a method of binding dispute resolution below, or do not subsequently agree in writing to a binding dispute resolution method other than litigation, Claims will be resolved by litigation in a court of competent jurisdiction.)

[« »] Arbitration pursuant to Section 15.4 of AIA Document A201–2007

[« »] Litigation in a court of competent jurisdiction

[«X»] Other *(Specify)*

«As specified in Specification 00800 Supplementary Conditions»

ARTICLE 7 TERMINATION OR SUSPENSION

§ 7.1 The Contract may be terminated by the Owner or the Contractor as provided in Article 14 of AIA Document A201–2007.

§ 7.2 The Work may be suspended by the Owner as provided in Article 14 of AIA Document A201–2007.

ARTICLE 8 MISCELLANEOUS PROVISIONS

§ 8.1 Where reference is made in this Agreement to a provision of AIA Document A201–2007 or another Contract Document, the reference refers to that provision as amended or supplemented by other provisions of the Contract Documents.

§ 8.2 Payments due and unpaid under the Contract shall bear interest from the date payment is due at the rate stated below, or in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.
(Insert rate of interest agreed upon, if any.)

«0.00» % «per annum»

§ 8.3 The Owner's representative:
(Name, address and other information)

«Mr. J. Alex Rosser, P.E.»
«Piedmont Triad Airport Authority
1000A Ted Johnson Parkway
Greensboro, NC 27409»
«Telephone Number: 336.665.5600»
« »
« »
«Email Address: rossera@gsoair.org»

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§ 8.4 The Contractor's representative:
(Name, address and other information)

« »
« »
« »
« »
« »
« »

§ 8.5 Neither the Owner's nor the Contractor's representative shall be changed without ten days written notice to the other party.

§ 8.6 Other provisions:

« »

ARTICLE 9 ENUMERATION OF CONTRACT DOCUMENTS

§ 9.1 The Contract Documents, except for Modifications issued after execution of this Agreement, are enumerated in the sections below.

§ 9.1.1 The Agreement is this executed AIA Document A101–2007, Standard Form of Agreement Between Owner and Contractor.

§ 9.1.2 The General Conditions are AIA Document A201–2007, General Conditions of the Contract for Construction.

§ 9.1.3 The Supplementary and other Conditions of the Contract:

Document	Title	Date	Pages

§ 9.1.4 The Specifications:
(Either list the Specifications here or refer to an exhibit attached to this Agreement.)

« »

Section	Title	Date	Pages

§ 9.1.5 The Drawings:
(Either list the Drawings here or refer to an exhibit attached to this Agreement.)

« »

Number	Title	Date

§ 9.1.6 The Addenda, if any:

Number	Date	Pages

Portions of Addenda relating to bidding requirements are not part of the Contract Documents unless the bidding requirements are also enumerated in this Article 9.

§ 9.1.7 Additional documents, if any, forming part of the Contract Documents:

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.1 ~~AIA Document E201™–2007, Digital Data Protocol Exhibit, if completed by the parties, or the following:~~

« »

.2 Other documents, if any, listed below:
(List here any additional documents that are intended to form part of the Contract Documents. AIA Document A201–2007 provides that bidding requirements such as advertisement or invitation to bid, Instructions to Bidders, sample forms and the Contractor's bid are not part of the Contract Documents unless enumerated in this Agreement. They should be listed here only if intended to be part of the Contract Documents.)

«00020 - Invitation to Bid
00100 - Instruction to Bidders
00310 - Bid Form for General Construction»

ARTICLE 10 INSURANCE AND BONDS

The Contractor shall purchase and maintain insurance and provide bonds as set forth in Article 11 of AIA Document A201–2007.
(State bonding requirements, if any, and limits of liability for insurance required in Article 11 of AIA Document A201–2007.)

Type of insurance or bond	Limit of liability or bond amount ($0.00)
As indicated in Article 11 of (00800) Supplementary Conditions	

This Agreement entered into as of the day and year first written above.

OWNER *(Signature)*	CONTRACTOR *(Signature)*
«Mr. Henry Isaacson»«, Chairman of the Board»	« »« »
(Printed name and title)	*(Printed name and title)*

DRAFT

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SECTION 00700 - GENERAL CONDITIONS

1.1 GENERAL CONDITIONS

A. The General Conditions of the Contract are the GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION, AIA Document A201 - 2007 Edition, are by reference, hereby made a part of the Contract Documents the same as if it were included in full herein.

B. Modifications specified in the SUPPLEMENTARY CONDITIONS supplement, change, delete from, and add to the above referenced AIA Document A201. Where articles, paragraphs, subparagraphs, and clauses are modified in the SUPPLEMENTARY CONDITIONS, the unaltered provisions of the articles shall remain in effect. Paragraphs not listed in the SUPPLEMENTARY CONDITIONS are not modified.

END OF SECTION 00700

SECTION 00800 - SUPPLEMENTARY CONDITIONS

General

A. These Supplementary Conditions modify, extend and add to provisions of the General Conditions for specific project requirements.

B. The General Conditions of the Contract for Construction, AIA Document A201, 2007 Edition, are the General Conditions for this Contract except as herein amended, deleted or supplemented. A copy of the referenced General Conditions is bound herein.

Referenced Articles

A. All Article numbers and titles of the referenced AIA General Conditions are referenced for continuity and convenience. New provisions added by these Supplemental Conditions shall be deemed to have been inserted in the General Conditions in the places called for by the numbering of such new provisions.

ARTICLE 1 - GENERAL PROVISIONS

1.1 Basic Definitions

Add the following:

1.1.1.1 The Drawings applicable to this Project are titled: PTIA Ticket Counter Ceiling Renovation, at the Piedmont Triad International Airport, Greensboro, North Carolina. The Drawings accompany these specifications and become a part hereof. In case of dispute, the Architect will identify the various sheets comprising the Drawings.

1.1.9 Provide

The term "provide" shall mean to furnish or install the work or item, complete, unless otherwise defined.

1.1.10 Sponsor

The word "sponsor" shall mean the Owner (Piedmont Triad Airport Authority).

1.2 Correlation and Intent of the Contract Documents

Add the following:

1.2.4 Reference to the standard specifications, manuals or codes of any technical society, organization or association, or to the code of any government authority, whether such reference be specific or by implication, shall mean the latest standard specification, manual or code in effect at the time of opening of Bids (or, on the effective date of the Agreement if there were no Bids), except as may be otherwise specifically stated. However, no provision of any referenced standard specification, manual or code (whether or not specifically incorporated by reference in the Contract Documents) shall change the duties and responsibilities of the Owner, the Contractor or the Architect, or any of their

agents or employees from those set forth in the Contract Documents. Clarifications and interpretations of the Contract Documents shall be issued by the Architect as provided in Section

ARTICLE 2 - OWNER

2.1 General

2.1.2 Delete entirely.

2.2 Information and Services Required of Owner

2.2.1 Delete entirely.

2.4 Owner's Right to Carry Out Work

2.4.1. Delete entirely and substitute the following:

2.4.1 If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within seven days after receipt of written notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, after seven days following receipt by the Contractor of an additional written notice and without prejudice to any other remedy the Owner may have, make good such deficiencies. In such case an appropriate Change Order shall be issued deducting from the payments then or thereafter due the Contractor the cost of correcting such deficiencies, including, without limitation, compensation for the Architect's additional services made necessary by such default, neglect or failure. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

ARTICLE 3 - CONTRACTOR

3.6 Taxes

Add the following:

3.6.1 For all materials incorporated into the Work under this contract, the Contractor shall furnish to the Owner a list of all purchases of such materials showing, with respect to each such purchase, the invoice number, date, the person or firm the invoice is from, the materials that were purchased, the cost of the materials, and the amount of North Carolina State Sales Tax that was payable in connection with such purchase. The Contractor shall certify that the list is correct and shall submit the list each month for materials used during the preceding month.

3.12 Shop Drawings, Product Data and Samples

Add the following:

3.12.6.1 The Contractor shall acknowledge each submittal with the Contractor's approval stamp. The approval stamp shall be signed or initialed and dated by the Contractor.

3.12.11 Certain sections of the Specifications state the requirements for submission of shop drawings, product data, and samples. Stated requirements of the Specifications for shop drawings and product data are waived for an item if such item is catalog stock and the Contractor, in lieu of submittal, states in writing that the exact item shown on the Drawings or mentioned in the Specifications will be used.

3.12.12 The Contractor shall not reproduce the Architect's project drawings for shop drawing use without written approval of the Architect.

3.12.13 By agreement with the Architect, the Contractor may submit more than the required number of copies. Receipt of less than the specified number of copies will be cause for the Architect withholding review of the shop drawings or data until receipt of the necessary additional copies.

3.12.14 In checking shop drawings, product data, and samples prior to submittal, the Contractor is requested to note corrections or comments on the drawings and product data in orange pencil.

3.18 Indemnification

Add the following:

3.18.3 Contractor shall indemnify and hold harmless the Owner from any penalties or fines levied upon the Owner for any violations of security laws or of any other rules or regulations, by the Contractor, by the Contractor's officers, agents or employees, by any of the Contractor's subcontractors or by any of the officers, agents or employees of any of the Contractor's subcontractors; and Contractor shall further indemnify the Owner from all expenses, including but not limited to attorneys fees, resulting from any such violations.

ARTICLE 4 - ARCHITECT

4.1 Architect

Add the following:

4.1.1.1 The terms Architect, Engineer, and Architect- Engineer mean the Architect.

4.1.2 Delete entirely and substitute the following:

4.1.2 The duties, responsibilities and limitations of authority of the Architect as set forth in the Contract Documents will not be extended without the written consent of the Owner, the Contractor and the Architect.

4.2 Administration of the Contract

4.2.9 Delete entirely and substitute the following:

4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion, will receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor, and upon approval by the Owner, will issue a final Certificate for Payment upon compliance with the Contract Documents.

4.2.10 Delete entirely and substitute the following:

4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project Representatives to assist the Architect in carrying out his responsibilities at the site.

4.2.11 Delete entirely and substitute the following:

4.2.11 Claims, disputes and other matters in question between the Contractor and Owner relating to the execution or progress of the Work or the interpretation of the Contract Documents shall be referred initially to the Architect for interpretation, which the Architect will render in writing within a reasonable time.

4.2.12 Delete entirely and substitute the following:

4.2.12 All interpretations of the Architect shall be consistent with the intent of and reasonably inferred from the Contract Documents and will be in writing or in the form of drawings. In the Architect's capacity as interpreter, the Architect will endeavor to secure faithful performance by both the Owner and the Contractor, will not show partiality to either, and will not be liable for the result of any interpretation rendered in good faith in such capacity.

ARTICLE 6 - CONSTRUCTION BY OWNER
OR BY SEPARATE CONTRACTORS

6.1 General

6.1.3 Delete entirely.

6.2 Mutual Responsibility

6.2.3 Delete entirely and substitute the following:

6.2.3 The Contractor shall reimburse the Owner for any costs the Owner incurs that are payable to a separate contractor because of the Contractor's delays, improperly timed activities or defective construction.

ARTICLE 8 - TIME

8.3 Delays and Extensions of Time

Add the following:

8.3.1.1 The time lost due to delays beyond the control of the Contractor will be considered to be equivalent to the number of days the path of critical events is lengthened by the delay regardless of the duration of the delay itself. If required by the Architect, the Contractor shall indicate this path of critical events, by diagram or narrative, in such detail as may be necessary to justify the claim and establish the number of days delay. The path of critical events is defined as the series of interdependent construction events that must be sequentially performed and that require a longer total time to perform than any other series.

8.4 Liquidated Damages

The Owner and Contractor recognize that time is of the essence with respect to the Contractor's completion of this Contract and that the Owner will suffer financial loss if the Work is not substantially completed within the time specified, plus any extensions thereof allowed in accordance with the General Conditions. They also recognize the delays, expense and difficulties involved determining, in a legal or arbitration proceeding, the actual loss suffered by the Owner if the Work is not substantially completed on time. Accordingly, instead of requiring any such proof (but not as a penalty), the Contractor shall pay the Owner liquidated damages equal to the following amount multiplied by the number of days that expire after the time specified for substantial completion until the Work is substantially complete:

Single Prime Contract: $ 1,000.00

ARTICLE 9 - PAYMENTS AND COMPLETION

9.10 Final Completion and Payment

9.10.1 Delete entirely and substitute the following:

9.10.1 Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspections and, when the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly, upon approval of the Owner, issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and belief, and on the basis of the Architect's observations and inspections, the Work has been completed in accordance with the terms and conditions of the Contract Documents and that the entire balance found to be due the Contractor, and noted in said final Certificate, is due and payable.

9.10.1.1 Final payment, constituting the entire unpaid balance of the Contract Sum, shall be paid by the Owner to the Contractor when the Work has been completed, the Contract fully performed, and a final Certificate for Payment has been issued by the Architect.

Add the following:

9.10.2.1 In addition to the other submittals required by Section 9.10.2, the Contractor shall also submit to the Owner, as a condition for final payment and for the payment of any remaining retainers, (6) a final sales tax report, in the format required by Section 3.6.1, and (7) a final report of Minority Business participation in the Work, in such form and with such detail as the Owner shall reasonably require. For this purpose, Minority Business participation in the Work shall be determined in accordance with Section 143-128.2 of the North Carolina General Statutes.

9.11 No Interest on Disputed Sums

No interest shall accrue on any sum alleged to be due from the Owner for so long as a bonafide dispute exists between the parties as to the Contractor's right to payment of such sum.

ARTICLE 11 - INSURANCE AND BONDS

11.1 Contractor's Liability Insurance

11.1.2 Delete entirely and substitute the following:

11.1.2 The insurance required by Section 11.1.1 shall be provided on an occurrence basis and shall be written for not less than the limits of liability specified in Section 11.1.5 or required by law, whichever coverage is greater. Coverages shall be maintained without interruption from the date of commencement of the Work until the date of final payment and termination of any coverage required to be maintained after final payment, and with respect to the Contractor's completed operations coverage, until the expiration of the period for correction of Work, or until two years after the date of final payment, whichever is later.

Add the following:

11.1.5 Limits of Contractor's Liability Insurance shall not be less than the following.

Type of Insurance and Limits of Liability:

1. Worker's Compensation:

   a. State: Statutory
   b. Employer's Liability

   $100,000__ each accident

2. Comprehensive General Liability including:

   Premises-Operations
   Independent Contractors
   Products & Completed Operations
   Broad Form Property Damage
   Contractual Liability
   Explosion & Collapse Hazard
   Underground Hazard
   Personal Injury
   Employment Exclusion Deleted

   a. Bodily injury (including products and completed operations):

      $ 500,000.00 each occurrence

      $ 500,000.00 aggregate

      Property damage:

      $ 500,000.00 each occurrence

      $ 500,000.00 aggregate

      Property damage and bodily injury combined:

      $ 500,000.00 each occurrence

      $ 500,000.00 aggregate

b. Applies to products and completed operations:

$ 500,000.00 aggregate (personal injury)

3. Comprehensive automobile liability including:

Owned, hired, non-owned

Bodily injury:

$ 250,000.00 each person

$ 500,000.00 each accident

Property damage:

$ 100,000.00

Bodily injury and property damage combined:

$ 100,000.00

4. Excess liability

Umbrella Form:

Bodily injury and property damage combined single limit:

$ 5,000,000.00 each occurrence

5. Aircraft liability (owned and non-owned when applicable). With limits proposed by the Contractor for Owner's approval.

11.4 Performance and Other Bonds

11.4.1 Delete entirely and substitute the following:

11.4.1 The Contractor shall furnish Performance and Payment Bonds, each an amount at least equal to the Contract Sum, as security for the faithful performance and payment of all the Contractor's obligations under the Contract Documents. The Contractor shall also furnish such other Bonds as may be required by these Conditions. The Performance and Payment Bonds shall be in the respective forms prescribed by Article 3 of Chapter 44A of the North Carolina General Statutes and shall obligate the Surety to the full extent and for the full term provided therein. All Bonds to be provided hereunder shall be executed by such Sureties as are licensed to conduct business in North Carolina. All Bonds signed by an agent must be accompanied by a certified copy of the authority to act. If the Surety on any Bond furnished by the Contractor is declared a bankrupt or becomes insolvent or its right to do business is terminated in North Carolina, the Contractor shall, within five days thereafter, substitute another Bond and Surety, both of which shall be acceptable to the Owner.

Add the following:

11.4.3 If notice of any change affecting the general scope of the Work or change in the Contract Sum is required by the provisions of any Bond to be given to the Surety, it will be the Contractor's responsibility to so notify the Surety, and the amount of each applicable Bond shall be adjusted accordingly. The Contractor shall furnish proof of such adjustment to the Owner.

ARTICLE 13 - MISCELLANEOUS PROVISIONS

Add the following:

13.8 Equivalent Materials and Equipment

13.8.1 Whenever materials or equipment are specified as described in the Drawings or Specifications by using the name of a proprietary item or the name of a particular manufacturer, fabricator, supplier or distributor, the naming of the item is intended to establish the type, function and quality required. Unless the name is followed by words indicating that no substitution is permitted, materials or equipment of other manufacturers, fabricators, suppliers, or distributors may be accepted by the Architect if sufficient information is submitted by the Contractor to allow the Architect to determine that the material or equipment proposed is equivalent to that specified. When an approved substitution is used, all adjustments, modifications and changes to the substituted item, and to the structure as may be necessary to install the item, maintain intended space requirements, design requirements, function and appearance, shall be made by the Contractor at no additional cost to the Owner.

13.8.2 Requests for review of substitute items of material and equipment will not be accepted by the Architect from any other source than the Contractor. If the Contractor wishes to furnish or use a substitute item of material or equipment the Contractor shall make written application to the Architect for acceptance. The Contractor shall certify that the proposed substitute will perform adequately the functions indicated by the general design, be similar and of equal substance to that specified and be suited to the same use and capable of performing the same function as that specified. The application shall state whether or not acceptance of the substitute for use in the Work will require a change in the Drawings or Specifications to adapt the design to the substitute and whether or not incorporation or use of the substitute in connection with the Work is subject to payment of any license fee or royalty. All variations of the proposed substitute from that specified shall be identified in the application and available maintenance, repair and replacement service will be indicated. The application shall also contain an itemized estimate of all costs that will result directly or indirectly from acceptance of such substitute, including the cost of redesign and claims of other contractors affected by the resulting change, all of which shall be considered by the Architect in evaluating the proposed substitute. The Architect will be the sole judge of acceptability, and no substitute will be ordered or installed without the Architect=s prior written acceptance. The Owner may require the Contractor to furnish at the Contractor’s expense a special performance guarantee or other surety with respect to any substitution.

13.8.3 The Architect will record the time required in evaluating substitutions proposed by the Contractor including time required by consultants and resultant changes in the Drawings and Specifications. Whether or not the Architect accepts a proposed substitute, the Contractor shall reimburse the Owner for the charges of the Architect and the Architect's consultants for evaluating any proposed substitute.

13.9 Preconstruction Conference

13.9.1 Before starting any construction work on this Project, a conference will be held in the Owner's office for the purpose of verifying general procedures, expediting shop drawings and schedules and to establish a working understanding between the parties concerned with this Project. The Contractor's representative and representatives of major subcontractors may also be present. The data and time of the conference shall be agreed upon by the Contractor and the Architect.

13.10 Compliance with Laws

13.10.1 Contractor, if applicable, assures that it will undertake an affirmative action program as required by 14 CFR Part 152, Subpart E, to ensure that no person shall on the grounds of race, creed, color, national origin, or sex be excluded from participating in any employment activities covered in 14 CFR Part 152, Subpart E. Contractor assures that no person shall be excluded on these grounds from participating in or receiving the services or benefits of any program or activity covered by said subpart. Contractor assures that it will require assurances from its suborganizations, as required by 14 CFR Part 152, Subpart E, to the same effect.

13.10.2 Contractor shall comply, at its own expense, with all applicable laws, rules, regulations and orders concerning civil rights and minorities now in force or hereafter prescribed or promulgated by Federal, State or local governments or Owner, whether foreseen or unforeseen or ordinary or extraordinary.

13.10.3 Contractor agrees to observe and comply with all requirements of the constituted public authorities, and all Federal, State and local statutes, laws, ordinances, rules, regulations and standards now and hereafter in force, which may be applicable to the operations of Contractor pursuant to this contract, including, but not limited to, such Rules and Regulations as may be adopted by the Owner and, without in any manner limiting the generality of the foregoing, rules and regulations of the Owner or other governmental unit pertaining to the use or employment of socially and economically disadvantaged individuals, laws, rules and regulations pertaining to the minorities, and laws, rules and regulations pertaining to disabled persons insofar as they may be applicable to Contractor.

13.11 Forum for Civil Actions

13.11.1 Any action or legal proceeding arising out of or related to this Contract shall be brought in the General Court of Justice of Guilford County, North Carolina or in the Federal District for the Middle District of North Carolina; and the parties hereby consent to and waive any objection to the jurisdiction or venue of said courts.

ARTICLE 14 - TERMINATION OR SUSPENSION OF CONTRACT

14.3 Suspension by the Owner for Convenience

14.3.2 Delete in its entirety and substitute the following:

14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay or interruption as described in Section 14.3.1. The adjustment of the Contract Sum shall not include any profit. No adjustment shall be made to the extent

1. that performance is, was or would have been so suspended, delayed or interrupted by another cause for which the Contractor is responsible; or

2. that an equitable adjustment is made or denied under another provision of the Contract.

14.4 Termination by the Owner for Convenience

14.4.3 Delete in its entirety and substitute the following:

14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work already executed, and any out-of-pocket costs that the Contractor incurs by reason of such termination, but shall not be entitled to any overhead or profit on work that had not been completed at the time of such termination.

ARTICLE 15 - CLAIMS AND DISPUTES

15.1 Claims

Add the following:

~~15.1.5.3 Allowances for "bad weather days" will be considered only for weather occurring from the time construction starts until the time when the building walls, if any, are erected and the construction is under roof. If the Contractor intends to designate a day as a "bad weather day," the Contractor must notify the Architect by the next business day of the Contractor's intention to make such claim. Failure by the Contractor to notify the Architect of such claim by the next business day shall result in a forfeiture of such claim. The Architect shall make a final determination as to whether to allow any such claim by the Contractor. The Contractor must document any claim of a "bad weather day" by data substantiating that weather conditions were abnormal on such day, could not have been reasonably anticipated and had an adverse effect on the scheduled construction.~~

15.1.7 Indemnities

Nothing in Section 15.1.6 shall constitute a waiver of or in any manner limit any indemnity that is owed to either the Owner or the Contractor under the other provisions of this Contract.

15.1.8 Limit on Owner's Liability for Delay

Notwithstanding any other provision of this Contract, the Contractor shall not be entitled to claim or recover any additional payment from the Owner by reason of any delay, obstruction or hindrance in the execution of the Work or any part thereof unless such delay, obstruction or hindrance is caused solely by the Owner or its agent. The phrase "owner or its agent" does not include prime contractors or their subcontractors.

15.3 Mediation

Add the following:

15.3.4 The Contractor shall ensure through its subcontracts with its subcontractors that the mediation procedure provided for in this Section 15.3 shall be available to all first-tier and lower-tier subcontractors with respect to any issues arising out of the Work or their respective contracts and that the costs of such mediation shall be divided equally among the parties to the dispute.

15.4 Arbitration

Delete Section 15.4 in its entirety and substitute the following:

15.4 No Arbitration

It is the intent of the parties that arbitration not be a required procedure in the dispute resolution process for this Contract. Therefore all provisions of the Contract Documents regarding arbitration are deleted.

END OF SECTION 00800

SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 CONTRACT DESCRIPTION

A. The Work will be performed under a separate prime contract.

1.2 PROJECT IDENTIFICATION AND SUMMARY

A. Project name is **"PTIA Ticket Counter Ceiling Renovation"**, Piedmont Triad International Airport", AEP No. 12-001-000, as shown on Contract Documents prepared by Lindsey Architecture.

B. Summary by References: Work of the contract can be summarized by references to the Contract, General Conditions, Modifications to General Conditions, Supplementary Conditions, Specification Sections, Drawings, addenda and modifications to the Contract Documents issued subsequent to the initial printing of this project manual and including but not necessarily limited to printed material referenced by any of these. It is recognized that work of the Contract is also unavoidably affected or influenced by governing regulations, natural phenomenon including weather conditions and other forces outside the contract documents.

C. Abbreviated Written Summary: Briefly and without force and effect upon the contract documents, the work of the Contract can be summarized as follows:

1. The work includes the construction of new airline ticket counter ceilings in the terminal building at the existing Piedmont Triad International Airport, Greensboro, North Carolina.

2. In general, the scope of the work shall include all equipment, materials, labor, etc., as required to complete the work as indicated by Contract Documents.

3. Work shall include, but shall not be limited to selective demolition and new construction all as shown on the drawings and/or specified.

4. The Contractor shall be responsible for providing a complete job in accordance with these drawings and specifications. The Contractor shall visit the site of the proposed work to determine for himself, the location and character of the work involved.

5. Contractor will be given notice to proceed after Owners review of bids and upon approval from the PTAA Board. The contractor should complete construction ready for Owner occupancy not later than 120 calendar days after the date of Notice to Proceed.

6. The use of sections throughout these specifications is not intended as an itemization of the various materials or the types of work or to the limit or to define the scope of any subcontract.

7. The Contractor will be held responsible for any and all fines that are assessed for lack of compliance to codes, or any requirements of a governing agency.

1.3 CONTRACTOR USE OF PREMISES

A. General: The Contractor shall limit his use of the premises to the work indicated.

B. Use of the Site: The Owner will be occupying and using the adjacent areas at all times. Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction. The Contractor shall schedule the work so that the adjacent tenant's work schedules are not interrupted.

END OF SECTION 01010

SECTION 01040 - COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:

1. General project coordination procedures.
2. Conservation.
3. Coordination Drawings.
4. Administrative and supervisory personnel.
5. Cleaning and protection.

B. Related Sections: The following Sections contain requirements that relate to this Section:

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1. Division 1 Section "Project Meetings" for progress meetings, coordination meetings, and preinstallation conferences.
2. Division 1 Section "Submittals" for preparing and submitting the Contractor's Construction Schedule.
3. Division 1 Section "Contract Closeout" for coordinating contract closeout.

1.3 COORDINATION

A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
3. Make provisions to accommodate items scheduled for later installation.

B. Where necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.

1. Prepare similar memoranda for the Owner and separate contractors where coordination of their work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and assure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of schedules.
2. Installation and removal of temporary facilities.
3. Delivery and processing of submittals.
4. Progress meetings.
5. Project closeout activities.

D. Conservation: Coordinate construction operations to assure that operations are carried out with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated in, the Work.

1.4 SUBMITTALS

A. Coordination Drawings: Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.

1. Show the relationship of components shown on separate Shop Drawings.
2. Indicate required installation sequences.
3. Comply with requirements contained in Section "Submittals."

B. Staff Names: Within 15 days of commencement of construction operations, submit a list of the Contractor's principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 GENERAL COORDINATION PROVISIONS

A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Coordinate temporary enclosures with required inspections and tests to minimize the necessity of uncovering completed construction for that purpose.

3.2 CLEANING AND PROTECTION

A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.

B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or

otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:

1. Excessively high or low humidity.
2. Air contamination or pollution.
3. Solvents.
4. Chemicals.
5. Light.
6. Combustion.
7. Electrical current.
8. Improper lubrication.
9. Unusual wear or other misuse.
10. Contact between incompatible materials.
11. Misalignment.
12. Excessive weathering.
13. Unprotected storage.
14. Improper shipping or handling.
15. Theft.
16. Vandalism.

END OF SECTION 01040

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for submittals required for performance of the Work, including the following:

1. Contractor's construction schedule.
2. Submittal schedule.
3. Daily construction reports.
4. Shop Drawings.
5. Product Data.
6. Samples.
7. Quality assurance submittals.
8. Approved Equal submittals

B. Administrative Submittals: Refer to other Division 1 Sections and other Contract Documents for requirements for administrative submittals. Such submittals include, but are not limited to, the following:

1. Permits.
2. Applications for Payment.
3. Performance and payment bonds.
4. Insurance certificates.
5. List of subcontractors.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Coordination" specifies requirements governing preparation and submittal of required Coordination Drawings.

1.3 DEFINITIONS

A. Field samples are full-size physical examples erected on-site to illustrate finishes, coatings, or finish materials. Field samples are used to establish the standard by which the Work will be judged.

B. Mockups are full-size assemblies for review of construction, coordination, testing, or operation; they are not Samples.

1.4 SUBMITTAL PROCEDURES

A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related elements of the Work so processing will not be delayed by the need to review submittals concurrently for coordination.

    a. The Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.

3. Processing: To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for resubmittals.

    a. Allow 2 weeks for initial review. Allow additional time if the Architect must delay processing to permit coordination with subsequent submittals.
    b. If an intermediate submittal is necessary, process the same as the initial submittal.
    c. Allow 2 weeks for reprocessing each submittal.
    d. No extension of Contract Time will be authorized because of failure to transmit submittals to the Architect sufficiently in advance of the Work to permit processing.

B. Submittal Preparation: Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.

1. Provide a space approximately 4 by 5 inches (100 by 125 mm) on the label or beside the title block on Shop Drawings to record the Contractor's review and approval markings and the action taken.
2. Include the following information on the label for processing and recording action taken.

    a. Project name.
    b. Date.
    c. Name and address of the Architect.
    d. Name and address of the Contractor.
    e. Name and address of the subcontractor.
    f. Name and address of the supplier.
    g. Name of the manufacturer.
    h. Number and title of appropriate Specification Section.
    i. Drawing number and detail references, as appropriate.

C. Submittal Transmittal: Package each submittal appropriately for transmittal and handling. Transmit each submittal from the Contractor to the Architect using a transmittal form. The Architect will not accept submittals received from sources other than the Contractor.

1. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from Contract Document requirements, including variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

1.5 CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Bar-Chart Schedule: Prepare a fully developed, horizontal bar-chart-type for each individual contractor's construction schedule. Submit within 10 days after the date the contract is awarded. Schedules are to be sent to the Project Coordinator, which shall be the general contractor.

B. Prepare a complete project schedule, compiled by the General Contractor, which includes coordinating and combining all other prime contractors within 20 days from the date the contract is awarded.

1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values."
2. Within each time bar, indicate estimated completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.
3. Prepare the schedule on a sheet, or series of sheets, of stable transparency, or other reproducible media, of sufficient width to show data for the entire construction period.
4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically the sequences necessary for completion of related portions of the Work.
5. Coordinate the Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittal Schedule, progress reports, payment requests, and other schedules.
6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.

B. Phasing: On the schedule, show how requirements for phased completion to permit Work by separate Contractors and partial occupancy by the Owner affect the sequence of Work.

C. Work Stages: Indicate important stages of construction for each major portion of the Work, including submittal review, testing, and installation.

D. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the Work. Indicate where each element in an area must be sequenced or integrated with other activities.

E. Distribution: Following response to the initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office.

1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

F. Schedule Updating: Revise the schedule after each meeting, event, or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

1.6 DAILY CONSTRUCTION REPORTS

A. Prepare a daily construction report recording the following information concerning events at the site, and have available for review by the Architect or Owner.
1. List of subcontractors at the site.
2. Approximate count of personnel at the site.
3. High and low temperatures, general weather conditions.
4. Accidents and unusual events.
5. Meetings and significant decisions.
6. Stoppages, delays, shortages, and losses.
7. Meter readings and similar recordings.
8. Emergency procedures.
9. Orders and requests of governing authorities.
10. Change Orders received, implemented.
11. Services connected, disconnected.
12. Equipment or system tests and startups.
13. Partial Completions, occupancies.
14. Substantial Completions authorized.

1.7 SHOP DRAWINGS

A. Submit newly prepared information drawn accurately to scale. Highlight, encircle, or otherwise indicate deviations from the Contract Documents. Do not reproduce Contract Documents or copy standard information as the basis of Shop Drawings. Standard information prepared without specific reference to the Project is not a Shop Drawing.

B. Shop Drawings include fabrication and installation Drawings, setting diagrams, schedules, patterns, templates and similar Drawings. Include the following information:

1. Dimensions.
2. Identification of products and materials included by sheet and detail number.
3. Compliance with specified standards.
4. Notation of coordination requirements.
5. Notation of dimensions established by field measurement.
6. Sheet Size: Except for templates, patterns and similar full-size Drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches (215 by 280 mm) but no larger than 36 by 48 inches (890 by 1220 mm).
7. Final Submittal: Submit 5 black-line prints.
8. Do not use Shop Drawings without an appropriate final stamp indicating action taken.

1.8 PRODUCT DATA

A. Collect Product Data into a single submittal for each element of construction or system. Product Data includes printed information, such as manufacturer's installation instructions, catalog cuts, standard color charts, roughing-in diagrams and templates, standard wiring diagrams, and performance curves.

1. Mark each copy to show applicable choices and options. Where printed Product Data includes information on several products that are not required, mark copies to indicate the applicable information. Include the following information:
   a. Manufacturer's printed recommendations.
   b. Compliance with trade association standards.
   c. Compliance with recognized testing agency standards.
   d. Application of testing agency labels and seals.
   e. Notation of dimensions verified by field measurement.
   f. Notation of coordination requirements.
2. Submittals: Submit 5 copies of each required submittal. The Architect will retain

one and will return the others marked with action taken and corrections or modifications required.

a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.

3. Distribution: Furnish copies of final submittal to installers, subcontractors, suppliers, manufacturers, fabricators, and others required for performance of construction activities. Show distribution on transmittal forms.

a. Do not proceed with installation until a copy of Product Data is in the Installer's possession.
b. Do not permit use of unmarked copies of Product Data in connection with construction.

1.9 SAMPLES

A. Submit full-size, fully fabricated Samples cured and finished as specified and physically identical with the material or product proposed. Samples include partial sections of manufactured or fabricated components, cuts or containers of materials, color range sets, and swatches showing color, texture, and pattern.

1. Mount or display Samples in the manner to facilitate review of qualities indicated. Prepare Samples to match the Architect's sample. Include the following:

a. Specification Section number and reference.
b. Generic description of the Sample.
c. Sample source.
d. Product name or name of the manufacturer.
e. Compliance with recognized standards.
f. Availability and delivery time.

2. Submit Samples for review of size, kind, color, pattern, and texture. Submit Samples for a final check of these characteristics with other elements and a comparison of these characteristics between the final submittal and the actual component as delivered and installed.

a. Where variation in color, pattern, texture, or other characteristic is inherent in the material or product represented, submit at least 3 multiple units that show approximate limits of the variations.
b. Refer to other Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, details of assembly, connections, operation, and similar construction characteristics.
c. Refer to other Sections for Samples to be returned to the Contractor for incorporation in the Work. Such Samples must be undamaged at time of use. On the transmittal, indicate special requests regarding disposition of Sample submittals.
d. Samples not incorporated into the Work, or otherwise designated as the Owner's property, are the property of the Contractor and shall be removed from the site prior to Substantial Completion.

3. Submittals: Except for Samples illustrating assembly details, workmanship, fabrication techniques, connections, operation, and similar characteristics, submit 2 sets. The Architect will return one set marked with the action taken.
4. Maintain sets of Samples, as returned, at the Project Site, for quality comparisons

throughout the course of construction.

a. Unless noncompliance with Contract Document provisions is observed, the submittal may serve as the final submittal.
b. Sample sets may be used to obtain final acceptance of the construction associated with each set.

B. Distribution of Samples: Prepare and distribute additional sets to subcontractors, manufacturers, fabricators, suppliers, installers, and others as required for performance of the Work. Show distribution on transmittal forms.

1. Field samples are full-size examples erected on-site to illustrate finishes, coatings, or finish materials and to establish the Project standard.

a. Comply with submittal requirements to the fullest extent possible. Process transmittal forms to provide a record of activity.

1.10 QUALITY ASSURANCE SUBMITTALS

A. Submit quality-control submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and other quality-control submittals as required under other Sections of the Specifications.

B. Certifications: Where other Sections of the Specifications require certification that a product, material, or installation complies with specified requirements, submit a notarized certification from the manufacturer certifying compliance with specified requirements.

1. Signature: Certification shall be signed by an officer of the manufacturer or other individual authorized to sign documents on behalf of the company.

C. Inspection and Test Reports: Requirements for submittal of inspection and test reports from independent testing agencies are specified in Division 1 Section "Quality Control."

1.11 APPROVED EQUAL SUBMITTALS

A. Submit approved equal submittals, including design data, certifications, manufacturer's instructions, manufacturer's field reports, and any information that is required for review, and other submittals as required under other Sections of the Specifications. The burden of proof of the merit of the proposed substitution is upon the proposer.

1. Submittal for an “Approved Equal” are to be submitted to the Architect not less than ten (10) days prior to bid.
2. Provide 12"x12" samples for each product submitted.
3. The Architect will review and issue a written action within seven (7) days of the submittal.
4. The Architects action on an “Approved Equal” submittal will be final.
5. If the Architect approved a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum.
6. Bidders shall not rely upon approvals made in any other manner.
7. No substitutions will be approved after award of the contract unless specifically provided for in the contract documents.

1.12 ARCHITECT'S ACTION

A. Except for submittals for the record or information, where action and return is required, the Architect will review each submittal, mark to indicate action taken, and return promptly.

1. Compliance with specified characteristics is the Contractor's responsibility.

B. Action Stamp: The Architect will stamp each submittal with a uniform, action stamp. The Architect will mark the stamp appropriately to indicate the action taken, as follows:

1. Final Unrestricted Release: When the Architect marks a submittal "No Exceptions Taken," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
2. Final-But-Restricted Release: When the Architect marks a submittal "Make Corrections Noted," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
3. Returned for Resubmittal: When the Architect marks a submittal "Amend and Resubmit," do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
    a. Do not use, or allow others to use, submittals marked "Amend and Resubmit" at the Project Site or elsewhere where Work is in progress.

4. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the Architect will return the submittal marked "Action Not Required."

D. Unsolicited Submittals: The Architect will return unsolicited submittals to the sender without action.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 01300

SECTION 01720 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes administrative and procedural requirements for Project Record Documents.

B. Project Record Documents required include the following:

1. Marked-up copies of Contract Drawings.
2. Field records for variable and concealed conditions.
3. Record information on Work that is recorded only schematically.

C. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Submittals" specifies general requirements for preparing and submitting Project Record Documents.
2. Divisions 2 through 16 Sections for specifying Project Record Document requirements for specific pieces of equipment or building operating systems.

D. Single Prime Contracts: The general contractor is responsible for obtaining, maintaining, and recording Project Record Document information for all of the subcontractors work. The Contractor for General Construction is responsible for coordinating information, where information from more than one prime contractor is to be integrated with information from other prime contractors to form one combined record.

E. Maintenance of Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition. Make documents and Samples available at all times for the Architect's inspections.

1.3 RECORD DRAWINGS

A. Markup Procedure: During construction, maintain a set of blue- or black-line white prints of Contract Drawings and Shop Drawings for Project Record Document purposes.

1. Mark these Drawings to show the actual installation where the installation varies from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include, but are not limited to, the following:

a. Dimensional changes to the Drawings.
b. Revisions to details shown on the Drawings.

c. Revisions to routing of piping and conduits.
d. Revisions to electrical circuitry.
e. Actual equipment locations.
f. Duct size and routing.
g. Locations of concealed internal utilities.
h. Changes made by change order or Construction Change Directive.
i. Changes made following the Architect's written orders.
j. Details not on original Contract Drawings.

2. Mark record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.
3. Mark record sets with red erasable colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.
4. Mark important additional information that was either shown schematically or omitted from original Drawings.
5. Note Construction Change Directive numbers, alternate numbers, change-order numbers, and similar identification.

B. Responsibility for Markup: The individual or entity who obtained record data, whether the individual or entity is the Installer, subcontractor, or similar entity, shall prepare the markup on record drawings.

1. Accurately record information in an understandable drawing technique.
2. Record data as soon as possible after obtaining it. Record and check the markup prior to enclosing concealed installations.
3. At time of Substantial Completion, submit record drawings to the Architect for the Owner's records. Organize into sets and bind and label sets for the Owner's continued use.

C. Copies and Distribution: After completing the preparation of record drawings, print (1) black-line prints of each drawing, whether or not changes and additional information were recorded. Organize the copies into manageable sets. Bind each set with durable-paper cover sheets. Include appropriate identification, including titles, dates, and other information on the cover sheets.

1. Organize and bind original marked-up set of prints that were maintained during the construction period in the same manner and submit to Architect.

1.4 RECORD SPECIFICATIONS

A. During the construction period, maintain 3 copies of the Project Specifications, including addenda and modifications issued, for Project Record Document purposes.

1. Mark the Specifications to indicate the actual installation where the installation varies from that indicated in Specifications and modifications issued. Note related project record drawing information, where applicable. Give particular attention to substitutions, selection of product options, and information on concealed installations that would be difficult to identify or measure and record later.

a. In each Specification Section where products, materials, or units of equipment are specified or scheduled, mark the copy with the proprietary name and model number of the product furnished.
b. Record the name of the manufacturer, supplier, installer, and other information necessary to provide a record of selections made and to document coordination with record Product Data submittals and maintenance manuals.

c. Note related record Product Data, where applicable. For each principal product specified, indicate whether record Product Data has been submitted in maintenance manual instead of submitted as record Product Data.

2. Upon completion of markup, submit record Specifications to the Architect for the Owner's records.

3. Each contractor is responsible for marking up Sections that contain its own Work.

a. The Contractor for General Construction is responsible for collecting marked-up record Sections from each of the other contractors. The Contractor for General Construction is also responsible for collating these Sections in proper numeric order with its own Sections to form a complete set of record Specifications.
b. The Contractor for General Construction is responsible for submitting the complete set of record Specifications as specified.

1.5 RECORD PRODUCT DATA

A. During the construction period, maintain one copy of each Product Data submittal for Project Record Document purposes.

1. Mark Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Product Data submitted. Include significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation.
2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
3. Note related Change Orders and markup of record Drawings, where applicable.
4. Upon completion of markup, submit a complete set of record Product Data to the Architect for the Owner's records.
5. Where record Product Data is required as part of maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as record Product Data.
6. Each prime contractor is responsible for marking up and submitting record Product Data for its own Work.

1.6 MAINTENANCE MANUAL SUBMITTAL

A. When each construction activity that requires submittal of maintenance manuals is nominally complete, but before Substantial Completion, submit maintenance manuals specified.

1. Organize operation and maintenance manuals into suitable sets of manageable size.
2. Bind data into individual binders for each manual, properly identified on front and spine. For large manuals, provide an index sheet and thumb tabs for separate information categories.
3. Provide heavy-duty, 3-ring, vinyl-covered binders, 1 to 2 inch (25 to 50 mm) thick as required to contain information, sized for 8-1/2-by-11-inch (215-by-280-mm) paper with inside pockets or pocket folders for folded sheets.
4. In each maintenance manual, include information specified in individual Specification Sections and the following:

a. Emergency instructions.
b. Spare parts list.
c. Copies of specific warranties.
d. Wiring diagrams.
e. Recommended maintenance procedures and turn-around times.

f. Inspection and system-test procedures.
g. Copies of applicable Shop Drawings and Product Data.
h. Listing of required maintenance materials and services.
i. Names and addresses of sources of maintenance materials.
j. Maintenance drawings and diagrams.
k. Precautions against improper maintenance and exposure.

5. Each prime contractor is responsible for maintenance manuals for its own Work. Where a manual includes information on installations by more than one contract, the Contractor who is the principal source of information, as designated by the Architect, shall receive information from other contractors, coordinate and collate information for a unified manual, and provide binders and submittal as specified.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 RECORDING

A. Post changes and modifications to the Documents as they occur. Do not wait until the end of the Project.

END OF SECTION 01720

SECTION 06202 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior trim.
2. Interior plywood, hardboard, board panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Samples: For each type of paneling.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Certified Wood: The following wood products shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

1. Interior trim.
2. Interior plywood, hardboard, board paneling.

B. Low-Emitting Materials: Composite wood products shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Lumber: DOC PS 20.

D. Softwood Plywood: DOC PS 1.

E. Hardboard: AHA A135.4.

F. MDF: ANSI A208.2, Grade 130, made with binder containing no urea-formaldehyde resin.

G. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea-formaldehyde resin.

2.2 INTERIOR TRIM

A. Softwood Lumber Trim:
1. Species and Grade: Douglas fir-larch or Douglas fir south, Superior or C & Btr Prime or D finish; NLGA, WCLIB, or WWPA.
2. Species and Grade: Southern pine, C & Btr finish; SPIB.
3. Maximum Moisture Content: 19 percent.

B. Hardwood Lumber Trim:

1. Species and Grade: Aspen, basswood, cottonwood, sap gum, sycamore, white maple, or yellow poplar; NHLA.
2. Maximum Moisture Content: 10% percent.

C. Moldings for Opaque Finish (Painted Finish): Made to patterns included in WMMPA WM 12.

1. Softwood Moldings: WMMPA WM 4, P grade.

a. Species: Eastern white, Idaho white, lodgepole, ponderosa, radiata, or sugar pine.
b. Maximum Moisture Content: 15 percent.

2. Hardwood Moldings: WMMPA HWM 2, P-grade.

a. Species: Aspen, basswood, cottonwood, gum, magnolia, soft maple, tupelo, or yellow poplar.
b. Maximum Moisture Content: 9 percent.

3. Optional Material: Primed MDF.

D. Molding Patterns:

1. As indicated on the drawings.

2.3 PANEL

A. Hardwood Veneer Plywood Panels: Manufacturer's stock hardwood plywood panels complying with HPVA HP-1**,** made without urea-formaldehyde adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Chesapeake Hardwood Products, Inc.
b. Georgia-Pacific Corp.
c. Holland Southwest International.

2. Face Veneer Species and Cut: Rotary-cut, wood type and finish to match existing.
3. Veneer Matching: Selected for similar color and grain.
4. Thickness: 1/8 inch.
5. Face Pattern: Manufacturer's standard channel-grooved pattern.

6. Finish: Manufacturer's standard, transparent, UV-resistant, protective finish, color to match existing.

2.4 MISCELLANEOUS MATERIALS

A. Low-Emitting Materials: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Paneling Adhesive: Comply with paneling manufacturer's written recommendations for adhesives.

1. Adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.2 INSTALLATION, GENERAL

A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Countersink fasteners, fill surface flush, and sand unless otherwise indicated.
3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
4. Install stairs with no more than 3/16-inch variation between adjacent treads and risers and with no more than 3/8-inch variation between largest and smallest treads and risers within each flight.

3.3 STANDING AND RUNNING TRIM INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

3.4 PANEL INSTALLATION

A. Wood Panels: Select and arrange panels on each wall to minimize noticeable variations in grain character and color between adjacent panels. Leave gaps as indicated on the drawings. Install with uniform tight joints between panels.

1. Attach panels to supports with manufacturer's recommended panel adhesive and fasteners. Space fasteners and adhesive as recommended by panel manufacturer.
2. Conceal fasteners to greatest practical extent.

END OF SECTION 06202

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

See Editing Instruction No. 1 in the Evaluations for cautions about named manufacturers and products. For an explanation of options and Contractor's product selection procedures, see Section 016000 "Product Requirements."

2.1 PERFORMANCE REQUIREMENTS

Retain "Fire-Resistance-Rated Assemblies" Paragraph below where gypsum board is part of fire-resistance-rated assemblies. Indicate design designations of specific assemblies on Drawings.

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

Retain "STC-Rated Assemblies" Paragraph below where gypsum board is part of STC-rated assemblies. Indicate design designations of specific assemblies on Drawings.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 INTERIOR GYPSUM BOARD

Retain "Manufacturers" Paragraph and list of manufacturers below to require products from manufacturers listed or a comparable product from other manufacturers.

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Gypsum.

2. CertainTeed Corp.

3. Georgia-Pacific Gypsum LLC.

4. Lafarge North America Inc.

5. National Gypsum Company.

6. PABCO Gypsum.

7. Temple-Inland.

8. USG Corporation.

B. Gypsum Wallboard: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.

C. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch.
2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.

B. Aluminum Trim: ASTM B 221, Alloy 6063-T5.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.5 AUXILIARY MATERIALS

A. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

A. Comply with ASTM C 840.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

D. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

1. Aluminum Trim: Install in locations indicated on Drawings.
2. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

E. Prefill open joints and damaged surface areas.

F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 09912 "Interior Painting."

3. Level 5: Where indicated on Drawings.

    a. Primer and its application to surfaces are specified in Section 09912 "Interior Painting."

H. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

I. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 09290

SECTION 09512 - ACOUSTICAL TILE CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Ceilings composed of acoustical tiles and concealed suspension systems.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 9 Section "Linear Metal Ceilings."

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of product specified.

C. Coordination drawings for reflected ceiling plans drawn accurately to scale and coordinating penetrations and ceiling-mounted items. Show the following:

1. Ceiling suspension system members.
2. Method of attaching suspension system hangers to building structure.
3. Initial direct-access openings.
4. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; sprinklers; and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
5. Minimum Drawing Scale: 1/8 inch = 1 foot.

D. Samples for initial selection in the form of manufacturer's color charts consisting of actual acoustical tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type of tile indicated.

E. Samples for verification of each type of exposed finish required, prepared on samples of size indicated below. Where finishes involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Set of 12-inch- (300-mm-) long samples of concealed suspension system members.
2. Set of 12-inch- (300-mm-) long samples of exposed moldings for each color and system type required.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed acoustical tile ceilings similar in material, design, and extent to that indicated for this Project and with a record

of successful in-service performance.

B. Fire-Test-Response Characteristics: Provide acoustical tile ceilings that comply with the following requirements:

1. Fire-response tests are performed by a qualified testing and inspecting agency. Qualified testing and inspecting agencies include Underwriters Laboratories (UL), Warnock Hersey, or another agency that is acceptable to authorities having jurisdiction and that performs testing and follow-up services.
2. Surface-burning characteristics of acoustical tiles comply with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84.

C. Single-Source Responsibility for Ceiling Tile: Obtain each type of acoustical ceiling tile from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

D. Single-Source Responsibility for Suspension System: Obtain each type of concealed suspension system from a single source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1. Obtain both acoustical ceiling units and suspension system from the same manufacturer.

E. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles and suspension system components to Project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Space Enclosure and Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet-work in spaces is completed and dry, work above ceilings is complete, and ambient temperature and humidity conditions are being maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical tiles and suspension system components with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system components (if any), and partition assemblies (if any).

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1. Acoustical Ceiling Tile: Furnish quantity of full-size units equal to 10 percent of amount

installed.

2. Suspension System Components: Furnish quantity of each component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following for each tile type indicated:

1. ACT-1

a. USG Corporation “Olympia Micro”. (Ceiling products shall match existing so substitutions will not be accepted.)

1) Type: ASTM E 1264, Type III, Form 2.
2) Materials: Wet-formed Mineral Fiber.
3) Pattern: Clima Plus
4) Edge Detail: FLB.
5) Size: 24" x 24" x 5/8".
6) Finish: Factory applied.
7) Color: As selected by Architect from manufacturers standard color palette.
8) Use Suspension System: USG “Donn Fineline DXF”.

2. ACT-2

b. Armstrong “Fine Fissured”. (Ceiling products shall match existing so substitutions will not be accepted.)

1) Type: ASTM E 1264, Type III, Form 2.
2) Materials: Wet-formed Mineral Fiber.
3) Pattern: 1728
4) Edge Detail: Square – Lay-in.
5) Size: 24" x 24" x 5/8".
6) Finish: Factory applied.
7) Color: As selected by Architect from manufacturers standard color palette.
8) Use Suspension System: Armstrong “Prelude XL”

2. Suspension Systems:

A Type:

1. USG Corporation “Donn Fineline DXF” Grid System main runners, hangers and accessories. (Suspension system products shall match existing so substitutions will not be accepted.)
2. Armstrong “Prelude XL” 15/16” Exposed Tee System.

B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the products specified in each Acoustical Tile Ceiling Product Data Sheet at the end of this Section.

C. Products: Subject to compliance with requirements, provide one of the products specified in each Acoustical Tile Ceiling Product Data Sheet at the end of this Section.

2.2 ACOUSTICAL TILE, GENERAL

A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.

B. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical tiles are indicated by reference to ASTM E 1264 pattern designations and not to manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range of products that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

C. Tile Characteristics: Comply with requirements indicated on each Acoustical Tile Ceiling Product Data Sheet at the end of this Section, including those referencing ASTM E 1264 classifications.

2.3 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C 635 requirements.

B. Finishes and Colors: Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.

1. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attachment of hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated Carbon Steel Wire: ASTM A 641 (ASTM A 641M), Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so that its stress at 3 times the hanger design load (ASTM C 635, Table 1, Direct Hung), will be less than the yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.

E. Sheet-Metal Edge Moldings and Trim: Type and profile indicated, or if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical tile edge details and suspension systems indicated; formed from sheet metal of same material and finish as that used for exposed flanges of suspension system runners.

1. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

2. Baked-Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Apply baked enamel according to paint

manufacturer's specifications for cleaning, conversion coating, and applying organic coating.

3. Manufacturer: Subject to compliance with requirements, provide aluminum accessories by one of the following:

    a. Fry Reglet Corporation.
    b. Gordon, Inc.
    c. MM Systems, Inc.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other Sections.

    1. Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordinating other work.

B. Testing Substrates: Before installing adhesively applied tile on wet-placed substrates such as cast-in-place concrete or plaster, test and verify that moisture level is below tile manufacturer's recommended limits.

C. Measure each ceiling area and establish the layout of acoustical tile to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width units at borders, and conform to the layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical tile ceilings to comply with publications referenced below per manufacturer's instructions and CISCA "Ceiling Systems Handbook."

    1. Standard for Ceiling Suspension System Installations: Comply with ASTM C 636.
    2. CISCA Recommendations for Acoustical Ceilings: Comply with CISCA "Recommendations for Direct-Hung Acoustical Tile and Lay-In Panel Ceilings."
    3. Installed as required for support of light fixtures, etc. per all applicable building codes.

B. Suspend ceiling hangers from building's structural members and as follows:

    1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of the supporting structure or of the ceiling suspension system.
    2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
    3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of 3 tight turns. Connect hangers either directly to structures or to inserts, eye screws, or other devices that are secure, that are appropriate for substrate, and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. Secure bracing wires to ceiling suspension members and to supports with a minimum of 4 tight turns. Fasten bracing wires to concrete with cast-in-place or postinstalled anchors.
7. Do not support ceilings directly from permanent metal forms. Fasten hangers to cast-in-place hanger inserts, powder-actuated fasteners, or drilled-in anchors that extend through forms into concrete.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise shown; and provide hangers not more than 8 inches (200 mm) from ends of each member.
11. Install hangars on all corners of lay-in light fixtures.

C. Install edge moldings and trim of type indicated at perimeter of acoustical tile ceiling area and where necessary to conceal edges of acoustical units.

1. Screw attach moldings to substrate at intervals not over 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.18 mm in 3.66 m). Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Arrange directionally patterned acoustical tiles as follows:

1. In the manner indicated on reflected ceiling plans.
2. Install tiles in a basket-weave pattern.

3.4 CLEANING

A. Clean exposed surfaces of acoustical tile ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's instructions for cleaning and touchup of minor finish damage. Remove and replace tiles and other ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09512

SECTION 09514 - CUSTOM METAL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Unperforated steel ceilings.
2. Patterned aluminum ceilings.
3. Extruded aluminum ceiling grid.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 9 Section "Acoustical Tile Ceilings" for mineral-base acoustical tile ceilings.
2. Division 15 Section "Air Outlets and Inlets" for grilles, registers, and diffusers in acoustical metal pan ceilings.
3. Division 16 Section "Interior Lighting Fixtures" for lighting fixtures in acoustical metal pan ceilings.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Structural Performance: Design, engineer, fabricate, and install interior metal ceiling systems to withstand the effects of loads and stresses from wind and normal thermal movement, without showing permanent deformation of ceiling system components including pans and suspension system; noise or metal fatigue caused by vibration, deflection, and displacement of ceiling units; and permanent damage to fasteners and anchors.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data for each type of product specified.
2. Coordination drawings for reflected ceiling plans drawn accurately to scale and coordinating penetrations and ceiling-mounted items. Show the following:

a. Joint pattern.
b. Ceiling suspension members.
c. Method of attaching hangers to building structure.
d. Ceiling-mounted items including light fixtures; air outlets and inlets; speakers; access panels; and special moldings at walls, column penetrations, and other junctures with adjoining construction.
e. Scale: 1/4 inch equals 1'-0".

3. Samples for initial selection purposes in form of manufacturer's color charts consisting of actual metal units or sections of units showing full range of colors, textures, and patterns available for each type of unit indicated.

a. 12-inch-square samples metal pan units.
b. 12-inch-long samples of each exposed molding and exposed trim.
c. 12-inch-square samples of patterned aluminum panels.

4. Product test reports from and based on tests performed by qualified independent testing laboratory showing compliance of metal ceiling system and components with requirements based on comprehensive testing of current products.
5. Qualification data for firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. The installer must submit a written certification by the system manufacturer. Include list of completed projects with project names, addresses, names of Architects and Owners, plus other information specified.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who is certified in writing by the system manufacturer.

B. Complete custom metal ceiling system to be installed by one installer.

C. Single-Source Responsibility: The installer is to be the single-source for complete system. Obtain each type of metal ceiling system with resources to provide coordination of and provide products of consistent quality in appearance and physical properties without delaying progress of the Work.

D. Coordination of Work: Coordinate layout and installation of acoustical ceiling units and suspension system components with other work supported by, or penetrating through, ceilings, including light fixtures and HVAC equipment.

E. Preinstallation Conference: Conduct conference at Project site to comply with specification requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal units to Project site in manufacturer's original unopened packages, fully identified with type, finish, performance data, and compliance labels. Handle and store in compliance with manufacturer's instructions and recommendations.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not install interior metal ceilings until space is enclosed and weatherproof and until wet work in space is completed and nominally dry.

1.8 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials matching products installed as described below, packaged with protective covering for storage, and identified with labels clearly describing contents.

1. Metal Units: Furnish quantity of full- size units.
   a. Provide four (4) panels of each length used in project.
2. Patterned Aluminum Ceiling Units: Furnish quantity of full-size units.
   a. Provide four (4) of each length used in project.

1.9 WARRANTY

A. Provide written warranty against defective workmanship and materials for a period of one (1) year from date of substantial completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide metal ceilings of the following:

1. Steel Ceilings:

a. Gordon, Inc., Shreveport, LA 71134

2. Patterned Aluminum Ceilings (Millennium Panels):

a. Baker Metal Products, Inc., Dallas, TX 75229

3. Extruded Aluminum Ceilings Grid:

a. Gordon, Inc., Shreveport, LA 71134

B. The listed manufacturers shall not be construed as closing specifications to other prospective manufacturers, but rather as establishing a level of quality in a metal system. Other systems may be submitted for approval as provided for in the specification at least 10 working days prior to submission of bids. Companies desiring to submit a proposal shall submit all descriptive information of the system proposed including photographs and shop drawings of at least three projects similar in detail and scope.

2.2 METAL CEILING SYSTEMS, GENERAL

A. Standard for Metal Ceiling Units: Provide units of configuration indicated that comply with ASTM E 1264 classifications as designated by reference to types, acoustical ratings, and light reflectances, unless otherwise indicated.

B. Sheet Metal Characteristics: Form metal pans from sheet metals selected for their surface flatness, smoothness, and freedom from surface blemishes where exposed to view in the finished unit. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, variations in flatness exceeding those permitted by referenced standards for stretcher-leveled metal sheet, stains, discolorations, or other imperfections.

C. Fabrication: Construct metal pans from metal indicated into units of size indicated and configuration standard with manufacturer, with either dimples, continuous beads, or spring clips on flanges for snap-in engagement with concealed suspension system, and finished to comply with requirements indicated on Drawings and under "Finishes" article.

D. Patterns: Where manufacturer's standard products are indicated, provide metal units complying with the following requirements:

1. Provide selections made by Architect from manufacturer's full range of standard patterns for products of type indicated.

2.3 CEILING SYSTEMS

A. Patterned Aluminum Panels (Millennium Panels): Extruded from aluminum sheet complying with ASTM B 209 and the following requirements:

1. Millennium panels shall be three-dimensional material 1/4" thick in sizes as shown on the drawings. The pattern shall be rounded top and bottom or flat top and bottom. Material shall be opaque in frontal view, with 40% open area as required for acoustical

performance. Pattern shall run the length of the sheet.

a. Aluminum sheet shall be 3003-14 alloy [ASTM B 209 (ASTM B 209M)].
b. Aluminum Extrusion shall be 6063-T6 Alloy [ASTM B221(ASTM B221M)].
c. Alloy and Temper for Baked Enamel Finish: 3003-H14 or 3105-H14, as standard with manufacturer.
d. Minimum Nominal Thickness: 0.050 inch (16 gage).
e. Pattern: Flat.
f. Noise Reduction Coefficient: NRC 0.70.
g. Acoustical backing (where indicated): Factory adhered to panel with a non-woven .008" thick black fabric, Class A, According to ASTM E-84. (Sound-Tex)

f. Size: As indicated.
i. Edge Detail: Square.

2.4 SUSPENSION SYSTEMS, GENERAL

A. Standard for Extruded Aluminum Suspension System: Provide ceiling manufacturers standard suspension systems of type, structural classification, material, and finish indicated that complies with applicable ASTM C 635. Provide systems that are complete with snap-in runners, splice plates, connector clips, alignment clips, hangers, trim, and other suspension components required to support ceiling units and other ceiling-supported construction.

2.5 DIRECT-HUNG METAL SUSPENSION SYSTEMS

A. System composed of snap-in main runners supported by hangers attached directly to building structure and complying with the following requirements:

1. Hangers: Angles or channels, as standard with ceiling system manufacturer, formed from same metal as main runners.
2. Main Runners: Formed from the following metal:

a. Aluminum Alloy: 6063T-5.
b. Aluminum Sheet: Alloy and temper recommended by manufacturer for use intended and as suitable for application of finish indicated, but with not less than the strength and durability properties specified in ASTM B 209 for 5005-H15.

3. Structural Classification: Intermediate-duty system.
4. Structural Classification: Heavy-duty system.
5. Maximum Deflection = L/360 (1/8" maximum).

2.6 MISCELLANEOUS COMPONENTS AND MATERIALS

A. Exposed Trim: Provide exposed members as indicated or required for edges of ceiling, fixture trim, beams, fascias at changes in ceiling height and other conditions, of metal and finish matching snap-in metal ceiling units.

B. Concealed Acoustical Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant complying with requirement specified in Division 7 Section "Joint Sealers."

C. Hidden trim or Accessories: Provide factory supplied or installed accessories, splice joints, angles, clips, hold-down, as indicated on Drawings from grid and metal ceiling manufacturers.

2.7 FINISHES, GENERAL

A. Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes for metal units and exposed trim.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent ceiling units are not acceptable. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are not acceptable.

C. All components of the custom metal ceiling are to be finished by patterned aluminum manfacturer (Baker Metal Products) to ensure all components are the same color.

2.8 ALUMINUM FINISHES

A. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.

B. Baked Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.

1. Factory applied and baked finish (for all components of custom metal ceiling system):

a. Fluropon.
b. Fluropon Classic II.
c. Acrodize.
d. Acroflur Paint.

2. Color and Gloss: As indicated by reference to manufacturer's standard color and gloss designations.
3. Color: As selected by Architect from manufacturer's standard choices for color and gloss.

2.9 STEEL SHEET FINISHES

A. Baked Enamel Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid chromate-fluoride-phosphate pretreatment; Organic Coating: as specified below). Apply baked enamel in compliance with paint manufacturer's specifications for cleaning, conversion coating, and painting.

1. Factory applied and baked finish (for all components of custom metal ceiling system):

a. Fluropon.
b. Fluropon Classic II.
c. Acrodize.
d. Acroflur Paint.

2. Color and Gloss: As indicated by reference to manufacturer's standard color and gloss designations.
3. Color: As selected by Architect from manufacturer's standard choices for color and gloss.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and structural framing to which ceiling system attaches or abuts, with Installer present, for compliance with requirements specified in this and other sections that affect installation and anchorage of ceiling system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

B. Measure each ceiling area and establish layout of metal units to balance border widths at opposite edges of each ceiling. Avoid use of less-than-half-width units at borders, and comply with reflected ceiling plans.

3.3 INSTALLATION

A. General: Install custom metal ceiling system in accordance with manufacturer's instructions and CISCA "Ceiling Systems Handbook" to comply with requirements indicated.

B. Standards for Installation of Ceiling Suspension Systems: Comply with ASTM C 636 and ASTM E 580 as applicable to metal ceilings.

C. Suspend ceiling hangers from building structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate, corrode, and fail with age or elevated temperatures.
4. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eyescrews, or other devices that are secure and appropriate for structure to which hangers are attached as well as for type of hanger involved, and in a manner that will not cause them to deteriorate or fail because of age, corrosion, and elevated temperatures.
5. Do not support ceilings directly from permanent metal forms; furnish cast-in-place hanger inserts that extend through forms.
6. Do not attach hangers to steel deck tabs.
7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
8. Space hangers not more than 4'-0" o.c. along each member supported directly from hangers, unless otherwise shown, and provide hangers not more than 8 inches from ends of each member.

D. Install edge moldings of type indicated at edges of each metal acoustical ceiling area and at locations where edge of units would otherwise be exposed after completion of work.

1. Sealant Bed: Apply continuous ribbon of acoustical sealant on back of vertical leg before fastening to vertical surface. Locate so that sealant will be concealed after installation.
2. Secure moldings to building construction by fastening through holes drilled in vertical leg. Space holes not more than 3 inches from each end and not more than 16 inches o.c. Draw up fasteners for tight set against vertical surfaces.
3. Miter corners of moldings accurately to provide hairline joints.

4. Level moldings with ceiling suspension system to level tolerance of 1/8 inch in 12'-0".
5. Use only items that have been finished in accordance with the finishes article or this specification section.

E. Scribe and cut metal acoustical units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet.

F. Install metal units in coordination with suspension system and exposed moldings.

1. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions, unless otherwise shown.
2. Fit adjoining units to form flush, tight joints. Scribe and cut units for accurate fit at borders and around construction penetrating ceiling.
3. Install directionally patterned or textured panels in directions indicated.
4. Install sound-absorptive pads in perforated metal units over metal spacer grids.
5. Install sound attenuation panels in areas indicated by reflected ceiling plans or room finish schedules. Lay panels directly on ceiling system in manner indicated, and close major openings to form complete coverage in required areas.

3.4 CLEANING

A. Clean exposed surfaces of metal ceiling including trim and edge moldings. Comply with manufacturers' instructions for cleaning and touchup of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 09513

SECTION 09912 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.

1. Wood.
2. Gypsum board.

1.2 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples: For each type of paint system and in each color and gloss of topcoat.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials**,** from the same product run**,** that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5% percent, but not less than 1 gal**.** of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

a. Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.

D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Colors: As selected by Architect from manufacturer's full range

2.3 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: MPI #50.

B. Primer, Alkali Resistant, Water Based: MPI #3.

C. Primer Sealer, Interior, Institutional Low Odor/VOC: MPI #149.

D. Primer, Latex, for Interior Wood: MPI #39.

E. Primer Sealer, Alkyd, Interior: MPI #45.

F. Primer, Bonding, Water Based: MPI #17.

G. Primer, Bonding, Solvent Based: MPI #69.

2.4 WATER-BASED PAINTS

A. Latex, Interior, Institutional Low Odor/VOC, Flat (Gloss Level 1): MPI #143.

B. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 2): MPI #144.

C. Latex, Interior, Institutional Low Odor/VOC, (Gloss Level 3): MPI #145.]

D. Latex, Interior, Institutional Low Odor/VOC, Semi-Gloss (Gloss Level 5): MPI #147.

E. Latex, Interior, High Performance Architectural, (Gloss Level 2): MPI #138.

F. Latex, Interior, High Performance Architectural, (Gloss Level 3): MPI #139.

G. Latex, Interior, High Performance Architectural, (Gloss Level 4): MPI #140.

H. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5): MPI #141.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Wood: 15 percent.
   2. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 CLEANING AND PROTECTION

A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR PAINTING SCHEDULE

A. Wood Substrates: Including wood trim, wood-based panel products:

1. Latex over Alkyd Primer System:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.
b. Intermediate Coat: Latex, interior, matching topcoat.
c. Topcoat: Latex, interior, flat, (Gloss Level 1), MPI #53.
d. Topcoat: Latex, interior, (Gloss Level 2), MPI #44.
e. Topcoat: Latex, interior, (Gloss Level 3), MPI #52.

f. Topcoat: Latex, interior, (Gloss Level 4), MPI #43.
g. Topcoat: Latex, interior, semi-gloss, (Gloss Level 5), MPI #54.
h. Topcoat: Latex, interior, gloss, (Gloss Level 6, except minimum gloss of 65 units at 60 degrees), MPI #114.

2. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Primer, latex, for interior wood**,** MPI #39.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1), MPI #143.
d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2), MPI #144.
e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3), MPI #145.
f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5), MPI #147.

3. Alkyd System:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.
b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
d. Topcoat: Alkyd, interior, (Gloss Level 3), MPI #51.
e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5)[, MPI #47.
f. Topcoat: Alkyd, interior, gloss (Gloss Level 6), MPI #48.

B. Gypsum Board Substrates:

1. Institutional Low-Odor/VOC Latex System:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
c. Topcoat: Latex, interior, institutional low odor/VOC, flat (Gloss Level 1)[, MPI #143.
d. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 2)[, MPI #144.
e. Topcoat: Latex, interior, institutional low odor/VOC, (Gloss Level 3)[, MPI #145.
f. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (Gloss Level 5)[, MPI #147.

2. Alkyd over Latex Primer System:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.
b. Intermediate Coat: Alkyd, interior, matching topcoat.
c. Topcoat: Alkyd, interior, flat (Gloss Level 1), MPI #49.
d. Topcoat: Alkyd, interior, (Gloss Level 3), MPI #51.
e. Topcoat: Alkyd, interior, semi-gloss (Gloss Level 5), MPI #47.
f. Topcoat: Alkyd, interior, gloss (Gloss Level 6), MPI #48.

END OF SECTION 09912

SECTION 15010B - MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 CODES, REGULATIONS, TAXES, PERMITS & FEES:

A. Work under this Division shall meet the applicable requirements of the following codes and standards:

1. Federal laws and regulations
2. North Carolina State Building Code, all volumes and parts
3. Health agencies having jurisdiction

4. Applicable code requirements shall govern where code requirements exceed the requirement of the Drawings and Specifications. The Drawings and Specifications shall govern where the work and materials specified exceed applicable code requirements.

B. The Contractor shall give all necessary notices, obtain all permits and pay all sales taxes, fees and other costs, including utility connections or extensions, in connection with his work; file all necessary plans, prepare all documents and obtain all necessary approvals of all authorities having jurisdiction; and deliver these to the Owner's representative before request for acceptance and final payment of the work.

C. The Contractor shall include in his work, without extra cost to the Owner, any labor, materials, service, apparatus, drawings, and the like, required in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on Drawings and/or specified.

D. All materials furnished and all work installed shall comply with the National Fire Codes of the National Fire Protection Association and with the requirements of all governmental departments having jurisdiction.

E. All materials and equipment for the electrical portion of systems shall bear the U.L. label, and shall be listed by the Underwriters' Laboratories, Inc.

F. All materials and equipment furnished under this Division shall be asbestos free.

1.3 REFERENCES:

A.	Air Conditioning and Refrigeration Institute	ARI
B.	American National Standards Institute	ANSI
C.	Air Moving and Conditioning Association	AMCA
D.	American Gas Association	AGA
E.	American Society for Testing and Materials	ASTM
F.	American Society of Heating, Refrigeration & Air Conditioning Engineers	ASHRAE
G.	American Society of Mechanical Engineers	ASME
H.	American Welding Society	AWS
I.	Anti-Friction Bearing Manufacturers Association	AFBMA
J.	Commercial Standards	CS
K.	Factory Mutual Corporation	FM
L.	Institute of Boiler and Radiator Manufacturers	IBR
M.	Industrial Risk Insurers	IRI
N.	Manufacturers' Standardization Society of the Valve & Fittings Industry (Standard Practice)	MSS SP
O.	National Electrical Code (NFPA 70)	NEC
P.	National Electrical Manufacturer's Association	NEMA
Q.	National Fire Protection Association	NFPA
R.	Sheet Metal & Air Conditioning Contractors National Association	SMACNA

S.	Steel Structures Painting Council	SSPC
T.	Underwriters Laboratories	UL
U.	United States Standard	USS

1.4 WORK:

A. Provide all labor, materials, equipment and supervision necessary for a complete installation and start-up of equipment and systems required by these Contract Documents.

B. These Specifications and Drawings are intended to require finished work, tested and ready for operation. Whenever the word "provide" is used, it shall mean "furnish and install complete and ready for use."

C. Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.

D. Work such as excavation, backfill, concrete, flashing, wiring, and the like, which is required by the work of this Division shall be performed in accordance with the requirements of the applicable section of the Specifications.

E. Some items of equipment may be specified in the singular; however, the Contractor shall provide and install the number of items of equipment as indicated on the Drawings, or as required for complete systems.

F. Provide all items required to complete the construction in accordance with reasonable interpretation of the intent of the Drawings and Specifications. Any minor items required by code, law or regulations shall be provided whether or not specified or specifically shown where it is a part of a major item of equipment, or of the control system specified or shown on the plans.

G. Conflicts between the requirements of this Specification, standards, purchase orders or design drawings shall be referred to the Owner's representative for clarification before proceeding with work on the affected parts.

1.5 EXAMINATION OF WORK SITE: Contractor and subcontractors shall, before submitting proposals, inform themselves of the conditions under which the work is to be performed, concerning the site of the work, the location of utilities, the structure of the building, the obstacles which may be encountered, and all other relevant matters concerning the work to be performed. No extra compensation will be allowed for failure to secure such information which was available prior to bidding. The successful Contractor shall employ, insofar as possible, such methods and means in the carrying out of this work as will not cause any interruption or interference with any separate Contractor or with Owner.

1.6 PRESENCE ON WORK SITE: Contractor shall comply with the Owner's general safety rules, including insurance requirements. Contractor shall instruct all of his employees and subcontractors and shall take all practicable measures to enforce compliance with all of the applicable safety and security rules and regulations in and adjacent to these areas, to insure the least possible interruption of or interference with Owner's operations and work by others.

1.7 PROJECT SCHEDULE: Contractor and subcontractors shall, before submitting proposals, inform themselves of the Project Schedule, phase requirements, and complexities associated with the construction of the work under this contract. The Contractor shall assess all pertinent aspects of manpower requirements, coordination, supervision, scheduling, mobilization, equipment procurement, demands of construction project management, and the like, to assure proper planning to meet the Project Schedule.

1.8 COORDINATION - GENERAL:

A. Contractor shall perform only the specific work assignments set forth in the contract. In all other respects the Contractor and his employees, and his subcontractors shall observe the rights of the Owner to control and assign work not specifically described in this contract without interference or interruption from the Contractor, or his employees, or his subcontractors.

B. Contractor shall effect cooperation between his employees and those of Owner and

Contractors on work awarded separately by the Owner, to the end that all work is properly anchored, installed and finished without hindrance or delay. Care shall be taken to avoid marring surfaces of the work of other Contractors, and each Contractor shall be held responsible for any damage to the work of others. Repair of new work shall be made by the original Contractor at the expense of the Contractor responsible for the damage.

C. Contractor shall obtain all necessary measurements of existing conditions and work by others in order that his work shall fit properly. No extra compensation will be allowed because of differences between actual dimensions and the measurements indicated on the Drawings.

D. The project will be observed by Owner's representative periodically as construction progresses. The Contractor will be responsible for notifying the Owner's representative at least 48 hours in advance when any work to be covered is ready for inspection. No work shall be covered or concealed until after observation has been completed on such items as piping, ductwork, insulation, and the like.

1.9 COORDINATION OF INSTALLATION OF FMS INSTRUMENTATION AND CONTROLS:

A. The Mechanical Contractor shall coordinate with the FMS Controls Contractor and the instrumentation and controls supplier regarding proper location and installation of sensing and control devices in piping, ductwork, and equipment. The FMS Controls Contractor shall be responsible for the sizing and selection of all sensors, primary signaling devices and controls, such as, but not limited to, flowmeters, temperature sensors, pressure sensors, thermo-wells, pressure taps, damper operators, valves, and the like. The FMS Controls Contractor shall also be responsible for providing instructions for the proper installation of his equipment, such as maintaining proper upstream and downstream straight-run dimensions on piping and ductwork to receive sensors.

B. The Mechanical Contractor shall install the primary sensing elements and controls provided by the FMS Controls Contractor. Installation of each item shall be as recommended by the FMS Controls Contractor and instrumentation and controls supplier. If the recommendation conflicts with or is substantially different from the Specifications and Drawings, the conflict or difference shall be resolved with the Owner's representative before proceeding.

C. The Mechanical Contractor shall be responsible for the final installation with regard to proper locations, workmanship and final insulation of equipment and systems in which the elements and controls are installed.

D. The Mechanical Contractor shall have sole responsibility for providing and installing self-contained instruments and controllers such as thermometers and pressure gages installed on piping, ductwork and equipment.

E. The FMS Controls Contractor shall provide all electrical work required for the controls systems, as described in Section 15900B and on the Drawings, all per the Electrical Specifications or specific installation requirements.

F. The Contractor is referred to the Instrumentation and Control Drawings and Specifications for information. Where instrumentation and/or controls are called for on one drawing, but are not shown on another, they shall be installed. Where an instrument, controller and/or indicator is shown or called for, but the primary sensing element or transmitter is not shown, the installation shall be provided, complete.

1.10 COORDINATION OF INSTALLATION OF FIRE SAFETY EQUIPMENT:

A. The Mechanical Contractor shall coordinate with the Electrical Contractor, Fire Alarm Equipment Supplier, Instrumentation and Controls Supplier, and others as necessary regarding proper location and installation of sensing and control devices in ductwork and equipment.

B. The Electrical Contractor shall be responsible for the sizing and selection of all sensors, primary signaling devices and controls, such as, but not limited to, temperature sensors and ionization or smoke detectors. The Electrical Contractor, and his supplier, shall also be responsible for providing instructions for the proper installation of his equipment, such as maintaining proper upstream and downstream straight-run dimensions on ductwork to

receive sensors.

C. The Mechanical Contractor shall install the primary sensing elements and controls provided by the Electrical Contractor. Installation of each item shall be as recommended by the Electrical Contractor. If his recommendation conflicts with or is substantially different from the Specifications and Drawings, the conflict or difference shall be resolved with the Owner's representative before proceeding. The Mechanical Contractor shall provide an access door immediately adjacent to each duct mounted ionization or smoke detector for servicing.

D. The Mechanical Contractor shall be responsible for the final installation with regard to proper locations as required by the Electrical Contractor, workmanship and final insulation of equipment and systems in which the elements and controls are installed.

E. The Electrical Contractor shall be responsible for the installation and operation of the Fire Safety Systems complete, except as described above.

F. The Contractor is referred to the Instrumentation and Control Drawings and Specifications, and to Division 16, Electrical, for information.

1.11 TEMPORARY FACILITIES AND CONTROLS:

A. Construction aids, such as scaffolds, staging, ladders, ramps, railings, hoists, cranes, chutes and other such facilities and equipment, and all tools, shall be provided by Contractor as necessary to accomplish the work.

B. Barriers shall be furnished, installed, and maintained as required to prevent public entry, and to protect the work, work by others, and areas accepted for substantial completion from construction operations.

1.12 DRAWINGS AND SPECIFICATIONS:

A. Contractor is cautioned to read the entire Contract Specifications and the entire set of Contract Drawings to assure that no reference to work by the Contractor is overlooked and to assure an understanding of the division of work between the various trades and/or contracts. Failure of the Contractor to do this shall not relieve him of any responsibility or remove any work from the contract.

B. The general arrangement of ductwork, piping and equipment shall be as shown on the Drawings. Detailed drawings of proposed departures due to actual field conditions or other causes shall be submitted to the Owner's representative for approval, and any such changes shall be made without additional cost to the Owner. The Contractor shall examine carefully all Contract Documents, and shall be responsible for the proper fitting of materials and equipment in each location as indicated, without substantial alteration.

C. The Drawings are generally diagrammatic. It is not possible to indicate all off-sets, fittings, and accessories which may be required. The Contractor shall investigate all potential obstructions carefully, plan ahead, and provide at no additional cost to the Owner such fittings, valves, transitions and accessories as may be required to meet such conditions.

D. Shop drawing plans and sections shall be submitted and approved for all mechanical equipment rooms, before proceeding with installation in these areas. See other Specification Sections regarding shop drawings.

E. The right to make any responsible change in location of apparatus, equipment, and/or routing of piping or ductwork, up to the time of roughing in, without involving any additional expense to the Owner, is reserved by the Owner's representative.

1.13 SURVEYS AND MEASUREMENTS:

A. The Contractor shall base all measurements, both horizontal and vertical, from established bench marks. All work shall agree with these established lines and levels. Verify all measurements at the site and check correctness of these as related to the work.

B. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the Drawings and

Specifications, he shall notify the Owner's representative and shall not proceed with his work until he has received instructions from the Owner's representative.

1.14 SHOP DRAWINGS AND PRODUCT DATA: Submit shop drawings, product data, and the like as required by Part 3 - Execution and by other applicable Specification Sections. Identify each item submitted using applicable Specification section number or Drawing reference.

1.15 RECORD DOCUMENTS: Contractor shall maintain at the project site one complete set of red-marked Contract Drawings and Specifications, continuously updated as the work progresses, to show all changes to the work and indicate actual installation of equipment and systems. The Contractor shall prepare complete Record Submittal Drawings from these red-marked documents for submittal to the Owner's representative as a part of the Contract Closeout submittals.

1.16 INSTRUCTIONS AND MAINTENANCE: Instruct Owners' operators in proper operation and maintenance of all equipment and controls. Supervise the operation of the system until the Owners' operators are familiar with the equipment and controls. See other Specification Sections for additional requirements.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS AND PRODUCT OPTIONS:

A. Contractor's Options:

1. For products specified only by reference standard, select any product meeting that standard.

2. For products specified by naming several products or manufacturers, select any one of the products or manufacturers named, which complies with the Specifications.

3. For products specified by naming one or more products or manufacturers and "or equal", Contractor shall submit a request for substitutions for any product or manufacturer not specifically named.

B. Substitutions: Contractor shall obtain written approval from Owner's representative for the use of substitute products, materials or manufacturers claimed as equal to those specified. Requests for substitution approvals shall be made by bidding Contractors and Subcontractors, and not by material and equipment suppliers. Requests for substitutions will be considered by the Owner's representative until ten (10) calendar days prior to bid date per the following guidelines:

1. Substitutions offered shall be supported by submittal of complete data.

2. Substitution submittal shall include manufacturer's data, test reports, performance data and certifications, dimensions, drawings, samples and other information as required to permit determination by the Owner's representative whether the offered substitute is equal to the specified standard.

3. Owner's representative shall be the judge of the acceptability of the proposed substitution.

4. The Owner's representative will review requests for substitutions and notify Contractor, in writing, of the decision to accept or reject the requested substitutions.

C. Contractor's Representation: A request for a substitution constitutes a representation that Contractor:

1. Has investigated the proposed product and determined that it is equal to or superior in all respect to that specified.

2. Has compared dimensions of the proposed product to the specified product, and has determined that the proposed product will fit properly in the available space, with adequate clearances for safety and maintenance.

3. Will provide the same warranties or bonds for the substitution as for the product specified.

4. Will coordinate the installation of an accepted substitution into the work, and make such other changes as may be required to make the work complete and operational in all respects.

5. Waives all claims for additional costs caused by the substitution which may subsequently become apparent.

D. Any substitute item installed on the project, which has not been approved in writing by the Owner's representative, shall be removed and replaced by the Contractor with the required specified item, at no cost to the Owner.

2.2 EQUIPMENT DEVIATIONS:

A. Where the Contractor proposes to use an item of equipment other than that specified or detailed on the Drawings, which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical, electrical, plumbing, structural, architectural or civil work, all such redesign, and all new drawings and detailing required therefore, shall be prepared by or for the Contractor at his own expense and submitted for approval by the Owner's representative.

B. Where such approved deviation requires a different quantity and arrangement of ductwork, piping, wiring, conduit, equipment, structures and the like from that specified or indicated on the Drawings, the Contractor shall furnish and install all such piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any additional material and equipment required by the system, at no additional cost to the Owner.

2.3 MATERIALS AND WORKMANSHIP:

A. Quality and Performance:

1. All materials and apparatus required for the work, except as particularly specified otherwise, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces.

2. Where no specific kind or quality of material is given, a first-class standard article as approved by the Owner's representative shall be furnished.

3. Conform to applicable Specifications and standards.

4. Comply with size, capacity, make, type, dimensions, and quality specified, unless variations are specifically approved in writing by Owner's representative.

5. Manufactured and Fabricated Products:

a. Design, fabricate, and assemble in accord with the best engineering and shop practices.

b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.

c. Two or more items of the same kind shall be by the same manufacturer.

d. Products shall be suitable for service conditions.

6. All hardware, such as nuts, bolts, washers, lockwashers, threaded rod, and the like, shall be adequately sized to do the intended job, and to take some physical abuse.

7. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

8. Except as specifically indicated or specified, materials and equipment removed from an existing structure shall not be used in the completed work.

B. Manufacturer's Instructions:

1. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such instructions to parties involved in the installation, including two copies to Owner's representative. Maintain one set of complete instructions at the job site during installation and until completion.

2. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.

a. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Owner's representative for further instructions.

b. Do not proceed with work without clear instructions.

3. Perform work in accord with manufacturer's instructions. Do not omit any preparatory step or installation procedure unless specifically modified or exempted by Contract Documents, or by Owner's representative in writing.

C. Transportation and Handling:

1. Arrange deliveries of products in accord with construction schedules; coordinate to avoid conflict with work and conditions at the site.

a. Deliver products in undamaged condition, in manufacturer's original containers or packaging, with identifying labels intact and legible.

b. Immediately on delivery, inspect shipments to assure compliance with requirements of Contract Documents and approved submittals, and to verify that products are properly protected and undamaged.

c. Promptly provide all labor and equipment necessary to receive, inspect, unload and store all deliveries.

2. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

D. Storage and Protection:

1. Contractor shall provide satisfactory means of weather and security protection for materials, products, tools and equipment, such as trailers or other enclosures.

2. Store products in accord with manufacturer's instructions, with seals and labels intact and legible.

a. Store products subject to damage by the elements in weathertight enclosures.

b. Maintain temperature and humidity within the ranges required by manufacturer's instructions.

3. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.

4. Protection After Installation: Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

2.4 ELECTRIC MOTORS:

A. Motors shall be furnished as a part of the equipment to be driven and shall meet applicable requirements of Division 16 - Electrical.

B. Enclosures shall be as scheduled on the Drawings or as required by the Equipment Specification Section. If not specified otherwise, enclosures shall meet code requirements and shall be appropriate for the service and location.

C. Motors shall be sized so as not to overload or to exceed nameplate current under any conditions of operation of the driven equipment. Motors shall be at least the horsepower indicated or specified.

D. Motors for use with variable speed drives shall be selected for proper continuous duty operation within the manufacturer's rated temperature limitations, at all operating speeds.

E. Motors shall be built in accordance with the latest standards of NEMA and as specified. Motors shall be tested in accordance with standards of ANSI/NEMA MG1 and conform thereto for insulation resistance and dielectric strength.

F. Each motor shall be provided with conduit terminal box and adequate starting and protective equipment as specified or required.

G. Each motor shall be selected for quiet operation, including those to be operated with variable speed drives.

H. Each motor and/or the overall piece of equipment it drives shall be UL, ETL, or CSA listed and so labeled.

2.5 FOUNDATIONS, SUPPORTS, PIERS, ATTACHMENTS:

A. Provide all hangers, miscellaneous steel, brackets and attachments necessary to adequately support equipment, ductwork, and piping installed under this Division.

B. All hangers, miscellaneous steel, brackets and attachments shall be connected only to the base building structure. Proper expansion anchors may be used into the structural floor above.

C. Steel supports and fastening devices shall be of structural quality. Steel supports shall be prime painted before installation. Any primer removed or damaged during installation shall be repainted or touched up with primer after installation.

D. The Mechanical Contractor shall coordinate closely with the Plumbing Contractor, Electrical Contractor, and Controls Contractor to confirm quantities and sizes of all utilities scheduled or required to be supported from the pipe, duct, or equipment supports. The Mechanical Contractor shall furnish locations, spacing, quantities and the like to the General Contractor for coordinating the installation with the structure. Refer to pipe support details for details of the permitted attachment types to the building structure.

E. Concrete structural bases and housekeeping pads shall be installed by the Mechanical Contractor for equipment designated on the Drawings and as required for leveling and elevation. Bases shall be provided where shown and as typically detailed. Each base shall have a rubbed finish and have top edges and side corners chamfered 45^{o}. Bases shall generally incorporate a minimum edge distance of ten (10) bolt diameters all around the outermost anchor bolt to allow development of full drill-in wedge anchor ratings, and shall generally be a minimum of 4 inches thick, with structural reinforcing and dowel anchors set into the floor with structural epoxy, unless shown otherwise on the Drawings.

F. Refer to Section 15201B for coordination of vibration and seismic requirements.

2.6 DIELECTRIC CONNECTIONS:

A. A dielectric connection shall be used at any point within the piping systems where dissimilar metals meet.

B. A dielectric isolating material shall be used at any point within the ductwork systems where dissimilar metals meet.

C. Supports, brackets, and hangers touching piping or ductwork shall be same material as piping or ductwork, or a dielectric isolation material shall be installed between the piping or ductwork and its supporting members.

2.7 ACCESS DOORS:

A. Access doors in building surfaces shall be furnished and installed by the General Contractor.

B. Access doors shall be provided for concealed equipment furnished under this division requiring periodic inspection, servicing or maintenance, where such equipment is located above nonremovable ceilings or behind walls.

C. 'B' Label Doors shall be used where installed in fire partitions.

D. Access doors shall be as specified in the Architectural sections of the Specifications, and on the Drawings.

E. Access doors in ductwork and related surfaces shall be provided by the Mechanical Contractor as specified in Section 15840B - Ductwork.

PART 3 - EXECUTION

3.1 GENERAL:

A. Contractor shall provide all materials and equipment called for in these Specifications and accompanying Drawings, complete in every respect. Anything called for in the Specifications and not shown on the Drawings or shown on the Drawings and not called for in the Specifications, shall be furnished by the Contractor.

B. Contractor shall follow the Drawings in laying out work and check drawings of other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, the Owner's representative shall be consulted before proceeding with the installation.

C. The Drawings are diagrammatic and are not intended to show each and every duct, pipe, fitting, valve, damper, pipe hanger, and the like, or a complete detail of all the work to be done; but are for the purpose of illustrating the type of system, showing pipe sizes, duct sizes, equipment locations, and the like, and special conditions considered necessary for the experienced mechanic to take off his materials and lay out his work. This Contractor shall be responsible for taking such measurements as may be necessary at the work site and adapting his work to local conditions.

D. Conditions sometimes occur which require certain changes in the Drawings and Specifications. In the event that such changes in the Drawings and Specifications are necessary, the same are to be made by the Contractor without expense to the Owner, providing that such changes do not require furnishing more materials, or performing more labor than the true intent and meaning of the Drawings and Specifications. It shall be understood that while the Drawings are to be followed as closely as circumstances will permit, the Contractor is held responsible for the installation of the system according to the true intent and meaning of the Drawings. Anything not entirely clear in the Drawings and Specifications will be fully explained if request is made to the Owner's representative. Should conditions arise where, in the judgement of the Contractor, certain changes will be advisable, the Contractor shall communicate with the Owner's representative and secure his approval of these changes before going ahead with the work.

E. Contractor shall visit the work site during bidding and familiarize himself with job conditions. No extras will be allowed because of additional work necessitated by, or change in plans required because of, evident job conditions that are not indicated on the Drawings.

3.2 WORKMANSHIP:

A. The Contractor shall furnish the services of an experienced superintendent, who shall be constantly in charge of the installation of the work, together with all skilled workmen, fitters,

metal workers, welders, helpers, laborers and the like, required to unload, transfer, erect, connect, adjust, start, operate and test each system.

B. All work shall be done by first-class and experienced mechanics, properly supervised. It is understood that the Owner's representative has the right to stop any work that is not being properly done and has the right to require that any workman, deemed incompetent by the Owner's representative, be removed from the job and a competent workman substituted therefore.

C. All equipment and material shall be installed in accordance with the recommendations of the manufacturer, unless otherwise specifically indicated on the Drawings or Specifications, or unless otherwise approved by the Owner's representative. This shall include the performance of such tests as the manufacturer recommends.

3.3 COOPERATION:

A. The Contractor shall give full cooperation to the Owner and other trades, and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. Where the work of the Contractor will be installed in close proximity to, or may interfere with work of the Owner or other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner, the Contractor shall prepare composite working drawings and sections at a suitable scale not less than 3/8" = 1'-0", clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordination with other trades, he shall make the necessary changes in his work to correct the condition without extra charge to the Owner.

C. The Contractor shall furnish to other trades, as necessary for coordination, all templates, patterns, setting plans, shop details, and the like for the proper installation of work and for the purpose of coordinating adjacent work.

D. Piping, ductwork, and equipment to be concealed in walls, floors, and ceilings shall be installed before walls, floors, and ceilings are constructed.

E. Penetrations or openings required in walls, floors and ceilings for piping, ductwork, equipment, or for any other reason, shall be sized, located and coordinated with other trades involved before construction of the walls, floors, and ceilings.

3.4 SAFETY REQUIREMENTS:

A. The finished installation of all systems and equipment shall be safe, creating no hazard when operating or at rest. All moving parts shall be covered with appropriate guards. All rough edges of equipment and materials shall be made smooth.

B. Applicable OSHA requirements shall be met in full.

3.5 MANUFACTURERS OF MATERIALS AND EQUIPMENT:

A. Contractor shall submit within twenty (20) calendar days after award of contract, seven (7) copies of a complete list of all manufacturers to be used on the job. No substitutions will be allowed after this date except in extenuating circumstances with approval of the Owner's representative.

B. Use of a manufacturer's name or equipment number in these Specifications or on the Drawings shall not be considered as equipment approval by the Owner's representative without confirming shop drawing submittal and approval.

3.6 SHOP DRAWINGS:

A. Contractor shall submit for approval detailed shop drawings of all equipment and materials listed in this section and in other Specification Sections. No materials or equipment required to be approved shall be delivered to the job site or installed until the Contractor has in his possession the approved shop drawings for the particular material or equipment. The

submittals of shop drawings shall be complete as described herein. Submit the number of copies required by the General and Special Conditions of the contract, but in no case less than seven (7) copies.

B. Shop drawings shall be submitted sufficiently in advance of requirements to allow the Owner's representative ample time for review and approval. Submit for approval detailed, dimensioned drawings or catalog cuts, showing materials, finishes, construction, size, arrangement, operating clearances, performance characteristics, capacity, and the like. Each equipment submittal shall include manufacturer's installation instructions. Submittals which lack installation instructions shall be returned.

C. Each item of equipment proposed shall be a standard catalog product of an established manufacturer and of equal quality, finish, performance, and durability to that specified. Each item shall comply with the requirement for Substitutions and Product Options described in this section.

D. No payment for any material, equipment or labor will be approved until all required shop drawings for that material, equipment and labor have been approved by the Owner's representative.

E. Failure of the Contractor to submit shop drawings in ample time for review and approval shall not entitle him to an extension of contract time, and no claim for extension by reason of default will be allowed.

F. All shop drawing submittals shall be in the office of the Owner's representative within 90 days after the contract has been awarded. The Contractor shall be financially responsible for any price increase of shop drawing items from the time shop drawings are issued until they are returned to the Contractor for purchase of items.

G. Shop drawing samples, drawings, specifications, or catalogs submitted for approval shall be properly labeled indicating specific service for which material or equipment is to be used, section and article number of specifications governing, Contractor's name and name of job.

H. Catalogs, pamphlets, or other documents submitted to describe items for approval shall be specific. Items submitted shall be clearly marked. Data of a general nature will not be accepted. Data shall include copies of computation sheets indicating how unit capacity was determined where ratings are at other than standard conditions. Submit the same number of copies as required for shop drawings.

I. The submittal of shop drawings shall have the Contractor's approval stamp affixed in a prominent place on each copy. This stamp shall indicate that the Contractor, by approving and submitting shop drawings, represents that he has determined and verified all field measurements and quantities, field construction criteria, materials, performance, and similar data; that he has reviewed and coordinated information in the shop drawings with the requirements of the work and the Contract Documents; and that any deviations from the Contract Documents have been clearly shown on the submittal.

J. Approval by the Owner's representative of shop drawings shall not be considered as a guarantee of quantities, measurements, or building conditions. Where drawings are provided, Owner's representative's approval does not mean that drawings have been checked in detail. Owner's representative's approval does not in any way relieve the Contractor from his responsibilities or the necessity of furnishing material and performing work as required by the Contract Drawings and Specifications.

K. The Contractor shall keep at the work site at all times at least one copy of all approved shop drawings. Shop drawings shall be properly indexed and filed in a filing cabinet for easy retrieval when questions arise.

L. Shop Drawing Submittals Required:

1. Coordination shop drawing plans and sections for each mechanical room of the building at a minimum scale of 1/4 inch=one foot, showing all equipment, ductwork, piping, grilles and registers, structural clearances, maintenance clearances and other trades, including major fire protection piping and major electrical conduit.
2. Fans, including fan curves, motors, details and dimensions.
3. Valves, including ball, gate, butterfly, check, circuit setter balancing, and other

types.

4. Ductwork construction standards
5. Pressure gages
6 Temperature gages
7. Flow measuring devices (fluid and air types)
8. Insulation - pipe, duct & equipment
9. Turning vanes
10. Grilles, registers, diffusers
11. Duct access doors, panels & test holes
12. Fire dampers
13. Flexible pipe connections
14. Strainers
15. Vibration isolation components
16. Pipe supports, hangers, and accessories
17. Mechanical identification for pipe, valves, ducts & equipment
18. Soldering materials
19. Motors (furnish data along with the driven equipment)
20. Flexible ductwork and accessories
21. Unit heaters
22. Variable speed drives
23. Starters
24. Variable air volume terminal units
25. Firestopping
26. Air filters
27. Piping materials - Certificates of Compliance
28. Test procedures
29. Air handling units with coils
30. Valves and hydronic specialties
31. Insulation pipe saddles
32. Welder's qualifications
33. FMS controls system drawings, product cut sheets, sequence of operation (complete) for all systems
34. Other specific submittals as required by Division 15B Specifications.

M. Submittal Drawings: Coordination shop drawings, drawings prepared of the mechanical equipment rooms, drawings prepared for the layout, fabrication and installation of piping, ductwork, and the like, drawings prepared to coordinate clearances with other trades, and other such drawings and sketches, shall be submitted as "shop drawings" for approval.

1. One complete set of approved Record Submittal Drawings shall be kept at the work site at all times, and shall be updated and maintained in the same manner as that required for Record Drawings. CAD (computer-aided-drafting) drawings shall also be updated and maintained for submittal as part of Project Closeout.

2. Record Submittal Drawings shall be subject to review and approval, and shall be submitted as required for review and approval, throughout the project.

N. Certificates of Compliance: Submit manufacturers' certificates of compliance with standards for all pipe and pipe fittings as specified in Section 15060B - Pipe and Pipe Fittings. Submit four (4) copies of the certificates to the Owner's representative. Certificates of Compliance shall be specific to the project and to the piping materials for which the certificate is submitted. Generalized, non-specific letters of compliance are not acceptable.

3.7 PERMITS, LICENSES, AND INSPECTION FEES: The Contractor shall obtain and pay for all permits and licenses required, give all legal notices and pay all fees for inspection or otherwise required for the work.

3.8 ACCESSIBILITY:

A. The Contractor shall be responsible for the sufficiency of the size of shafts and chases, and the adequate clearance in double partitions and hung ceilings for the proper installation of his work. He shall cooperate with the General Contractor and all other contractors whose work is in the same space, and shall advise the General Contractor of his requirements. Such spaces and clearances shall, however, be kept to the minimum size required.

B. The Contractor shall locate all equipment which must be serviced, operated or maintained in fully accessible positions. Equipment shall include but not be limited to sensors, controls, fire dampers, valves, traps, cleanouts, vent and drain points.

C. Provide access doors in ductwork, equipment, and the like as required for good maintenance and service access.

D. The Contractor shall arrange for access doors required in building surfaces, which are to be provided by the General Contractor. The Contractor shall provide the General Contractor the exact locations of access doors needed for equipment, concealed valves, controls, or other devices requiring service. Locations of these doors shall be submitted in sufficient time to be installed in the normal course of the work.

E. Minor deviations from Drawings may be made to allow for better accessibility, and changes shall be submitted to the Owner's representative for approval.

3.9 CUTTING AND PATCHING:

A. Mechanical Contractor shall provide all cutting and patching necessary to install the work specified in this Division, unless noted otherwise. Patching shall match adjacent surfaces, or new finishes as specified.

B. No structural member shall be cut without the specific approval of the Owner's representative except as specifically detailed on the Drawings. All such cutting and reinforcing shall be done in a manner directed by the Owner's representative.

C. Cutting and patching of footings after general construction will not be permitted.

D. The General Contractor shall provide all duct and pipe openings, chases and shafts in all existing and new construction; however, it is this Contractor's responsibility to advise exact dimensions, shape, and locations of openings required in sufficient time for the General Contractor to make the necessary provisions. This Contractor shall be responsible for the correct size and location of each opening for his equipment even though these openings are provided by the General Contractor.

E. Contractor shall arrange for necessary openings in building to admit his equipment. If it becomes necessary to cut any portion of building to admit his equipment, Owner's representative's approval shall be obtained before cutting, and portions cut shall be restored to their former condition by this Contractor.

3.10 SLEEVES, INSERTS AND PLATES:

A. This Contractor shall provide and locate all sleeves and inserts required before new floors and walls are built, or shall be responsible for the cost of cutting and patching required where sleeves and inserts were not installed, or where incorrectly located.

B. In existing construction, this Contractor shall furnish and locate all sleeves and inserts before openings in floors and walls are cut, or shall be responsible for the cost of cutting and patching required where sleeves and inserts were incorrectly located. This Contractor shall install sleeves and inserts.

C. Where possible, openings in existing shall be core drilled or saw cut, neatly and cleanly.

D. Sleeves shall be provided for all duct and pipe passing through concrete floor slabs and concrete, masonry, tile, plaster and gypsum wall construction. Sleeves shall not be provided for piping running imbedded in concrete or in insulating concrete slabs on grade.

E. Sleeves shall not be required for smooth core drilled holes in existing concrete construction, unless specifically required by details or notes on the Drawings.

F. This Contractor shall do all drilling required for the installation of hangers, inserts and other components.

3.11 PROTECTION:

A. Contractor shall protect all work and material from damage, and shall be liable for all damage during construction.

B. Contractor shall be responsible for work and equipment until all construction is finally inspected, tested, and accepted. He shall protect work against theft, injury or damage; and shall carefully store material and equipment received on site which are not immediately installed. He shall close open ends of work, including ductwork, pipe and equipment, with temporary covers or plugs during storage and construction to prevent entry of obstructing materials.

C. See the Contract Documents, including the General Conditions, Supplementary General Conditions and General Requirements.

3.12 HOUSEKEEPING AND CLEANING:

A. Refer to General Conditions and Supplementary General Conditions.

B. Maintain the work site and surrounding areas reasonably clean and free of dirt, debris, waste and surplus materials.

C. Maintain clean and safe working conditions for Contractor's personnel, Owner's representative's personnel, and Owner's personnel. Contractor shall cooperate fully with Owner's representative in this matter.

D. Daily: During construction, execute daily cleaning to keep the work, the site and adjacent properties free from accumulations of waste materials, rubbish and windblown debris, resulting from construction operations.

E. Waste Containers: Provide on-site containers for the collection of waste materials, debris and rubbish.

F. Waste Removal: Remove waste materials, debris and rubbish from the site periodically and dispose of at legal disposal areas away from the site.

G. Dust Control: Schedule operations so that dust and other contaminants resulting from work will not interfere with other operations.

H. Final Cleaning:

1. Execute prior to Substantial Completion and again prior to Final Inspection.

2. Employ skilled workmen for final cleaning.

3. Remove grease, mastic, adhesive, dust, dirt, stains, fingerprints, labels, and other foreign materials from sight-exposed interior and exterior surfaces.

4. Clean or replace all filters.

5. Remove waste and surplus materials, rubbish, and construction facilities from the Project and from the site.

6. Prior to final completion, Contractor shall conduct an inspection of sight-exposed interior and exterior surfaces, and all work areas, to verify that the entire work is clean.

3.13 PAINTING: Touch up, or repaint completely, equipment on which factory paint has been damaged. Paint all miscellaneous support steel exposed to weather or visible within an occupied space or mechanical room. Painting materials and methods shall be as specified under the Specification Division and Section titled "Painting".

3.14 IDENTIFICATION OF EQUIPMENT, PIPING & DUCTWORK: All mechanical equipment, piping, ductwork and controls furnished and/or installed under this division, shall be identified by nameplates or tags as specified in separate section, Mechanical Identification.

3.15 PLACING IN SERVICE:

A. Before being placed into operation, each item of equipment shall be serviced in accordance with the requirements of these Specifications and the manufacturer's recommendations. This servicing shall include alignment, lubrication, instrument liquids, instrument and control calibrations and adjustments, testing and adjusting of operating controls.

B. Prior to final inspection, demonstrate operation of each system to Engineer and Owner.

C. Instruct Owner's personnel in operation, adjustment, and maintenance of equipment and systems, using the operation and maintenance data as the basis of instruction.

D. Prior to Final Acceptance of the work, for items so designated in individual Specification Sections, an authorized representative of each manufacturer of materials and/or equipment installed in the work shall personally inspect the installation and operation of his materials systems, and/or equipment to determine that they are correctly installed and operating properly.

1. Inspection and testing shall be accomplished:

a. For work which will be concealed: during the course of the work, after completion of installation and prior to concealment.

b. For work which will not be concealed: at completion of the work.

2. Each representative shall submit a signed statement to the Engineer, certifying to his personal inspection and to the correct installation and proper operation of materials, systems and/or equipment. Their certification shall list the items included.

3. The Contractor shall transmit all such certifications to the Engineer at or prior to the Final Acceptance Inspection. The transmittal shall include a list of all certifications included.

E. Ducts, plenums and casings shall be cleaned of all debris and blown free of all particles of rubbish and dust before startup.

F. Piping shall be continuously flushed with clean water until flushing water leaving the piping runs clean. Flushing shall be done at sufficient velocity to ensure proper cleaning.

G. Motors shall be "bumped" to assure proper rotation.

H. Alignment of all shafts, couplings, pulleys, belts and the like, shall be verified.

3.16 TESTING AND BALANCING: Provide complete testing and balancing of all systems and equipment, as specified in separate section of this Specification Division.

3.17 OPERATIONAL TESTS AND SERVICING:

A. In addition to testing, balancing, and commissioning specified elsewhere in this division of the Specifications, the Contractor shall make all tests, trial operation balancing and balance tests, and the like, as specified and as directed by the Owner's representative to prove that all work under these Drawings and Specifications is in complete serviceable condition and will function as intended. All costs of tests shall be borne by Contractor.

B. Pulley sizes and belts shall be adjusted or changed as necessary to obtain the specified performance.

C. All controls, valves and equipment shall be adjusted to settings indicated.

D. At the completion of performance runs, the Contractor shall recheck all equipment and verify that each item is functioning correctly.

E. Upon completion of all work, each system shall be tested to determine if any excess noise or vibration is apparent during operation of the system. If any such objections are detected in the system or equipment, the Contractor shall be responsible for correcting the problem.

F. Bearings shall be re-lubricated as recommended by the equipment manufacturer.

3.18 VIBRATION ISOLATION:

A. All work shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Owner's representative.

B. For moving machinery, sound or vibration noticeable outside of the room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable.

C. Sound or vibration conditions considered objectionable by the Owner's representative shall be corrected in an approved manner by the Contractor at the Contractor's expense.

3.19 ACCEPTANCE OF EQUIPMENT: In the event that the Owner considers it impractical, because of unsuitable test conditions or some other factor, to execute simultaneous final acceptance of all equipment, portions of the installation may be certified by the Owner's representative for final acceptance when that portion of the system is complete and ready for operation.

3.20 OPERATION & MAINTENANCE INSTRUCTIONS:

A. Submit four (4) sets of complete descriptive information, operating and maintenance instructions and spare parts lists for all equipment installed under this contract. All information shall be assembled in three ring binders with index tabs to identify each item of major equipment and each system.

B. Provide title sheet with job name, and the names, addresses and phone numbers of the Contractor, subcontractor, control subcontractor, related contractors, and material and equipment suppliers.

C. Each manual shall be self-contained and include information for efficient servicing of equipment supplied and installed under the contract.

D. Operating instructions shall explain maintenance procedures, methods of checking the systems for safe and normal operation, and the recommended procedure for safely stopping and starting the equipment and/or system.

E. Provide in each operating and maintenance manual the following data, as required by the State Energy Code, paragraph 403.2.10:

1. HVAC Control Information

2. Certified Air and Water Balancing Report

3. Control System Certification Letter regarding installation and testing

F. Instruct Owner's personnel in proper operation and maintenance of all equipment and controls.

G. These requirements shall be fulfilled before any guarantee periods become effective so as to limit the possibility of claims arising from the absence of pertinent information.

3.21 GUARANTEE:

A. The Contractor shall guarantee the complete systems against defect due to faulty materials, faulty workmanship or failure due to negligence of the Contractor. This guarantee will exclude normal wear, maintenance, lubrication, replacement of expendable components, or abuse. During the guarantee period, the Contractor shall make good such defective workmanship and materials and any damage resulting therefrom, within a reasonable time of notice given by the Owner.

B. The period of Guarantee for all materials, labor and equipment shall be 12 months from the date of final acceptance of the work unless noted otherwise. The period of guarantee on the affected equipment and systems shall be extended as necessary to provide one full season of operation of the cooling systems and of the heating systems.

C. Where items of equipment or material carry a manufacturer's warranty for a period in excess of twelve (12) months, the manufacturer's warranty shall apply for that particular piece of equipment or material.

3.22 CONTRACT CLOSEOUT SUBMITTALS:

A. All close-out submittals shall be completed satisfactorily before final application for payment will be approved.

B. Evidence of compliance with requirements of governing authorities shall be submitted.

C. As the construction of the project nears completion, collect all guarantees, warranties, affidavits that all payrolls and bills have been paid, Consent of Surety to final payment, certificates of inspection, operating manuals, keys and keying schedule, Project Record Drawings and other items required, in the number of copies specified, to be delivered to the Owner upon completion of the project.

D. When Contractor considers work has reached final completion, submit written certification that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Engineer's inspection.

E. In addition to submittals required by the conditions of the Contract, provide submittals required by governing authorities, and submit a final statement of accounting giving total adjusted Contract Sum, previous payments, and sum remaining due.

F. Project Record Documents:

1. Provide one complete set of Contract Drawings and Specifications marked in red with all changes to the work to indicate actual installation.

2. Provide one complete set of As-Built Record Submittal Drawing prints.

3. These records are a specific contract requirement, and final payment will not be made until these Drawings and Specifications have been submitted in an acceptable form.

4. Store Project Record Documents separate from those used for construction and in accordance with Section 01720.

5. Keep documents current; do not permanently conceal any work until required information has been recorded.

6. At contract closeout, submit documents with transmittal letter containing date, project title, Contractor's name and address, list of documents, and signature of Contractor.

7. Contract Drawings and Shop Drawings: Legibly mark each item to record actual construction, including:

a. Measured locations of internal utilities and appurtenances concealed in construction, referenced, by dimension and otherwise, to visible and accessible features of construction.

b. Field changes of dimension and detail.

c. Changes made by modifications.

d. Details not on original Contract Drawings.

e. References to related shop drawings and modifications.

8. Specifications: Legibly mark each item to record actual construction, including:

a. Manufacturer, trade name, and catalog number of each product actually installed, particularly optional items and substitute items.

b. Changes made by Addenda and Modifications.

9. Other Documents: Maintain manufacturer's certifications, inspection certifications, field tests and startup, records, and other information required by individual Specification sections.

G. Operating & Maintenance Manuals: Submit as described elsewhere in this section.

H. Testing, Adjusting, and Balancing Reports: Submit as described elsewhere in this Specification Division.

I. Spare parts and maintenance materials, if required by these Contract Documents, shall be delivered to Owner as directed by Owner's representative.

J. Statement of payment of taxes.

K. Affidavit of Payment of Debts and Claims.

L. Affidavit of Release of Liens.

END OF SECTION 15010B

SECTION 15035B - MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 REFERENCES: ANSI Z53.1 - Safety Color Code for Marking Physical Hazards.

1.3 SUBMITTALS: Submit shop drawings in accordance with Section 15010B. Submittals shall include, but not be limited to, the following:

A. Submit legend, list of wording, abbreviations, symbols, letter size, and color coding for all mechanical identification.

B. Submit pipe identification coatings; including color schemes, color field, legend coating specification, and material safety data sheets (MSDS).

C. Submit pipe identification plastic snap or strap-around markers; including color scheme, size, color field and legend.

D. Submit underground warning tape showing color scheme, color field, legend, size and construction specifics (polyethylene and metallic).

E. Submit plastic nameplates showing material, color schemes, size, lettering and attachment.

F. Submit conduit identification plastic snap-around markers; including color scheme, size, color field and legend.

G. Submit manufacturer's installation instructions for all products.

1.4 SAMPLES:

A. Submit representative samples of valve tags, equipment labels, underground tapes, conduit markers and pipe markers for approval.

B. Submit a complete "as installed" sample of stencil painting of pipe labels for approval of color field, text size, clarity and stencil method quality. Stenciling will not be allowed without confirming sample submittal for quality control.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Identification Markers and Components:

1. Almetek Industries
2. Brady USA, Inc.
3. Craftmark Identification Systems
4. Panduit Corporation
5. Seton Name Plate Company

B. Identification Coatings:

1. Sherwin-Williams
2. Duron
3. Benjamin Moore and Company
4. Glidden
5. Pittsburgh Paints
6. Substitutions: In Accordance with Section 15010B.

2.2 PIPING IDENTIFICATION:

A. Legend:

1. Positive identification of the contents of a piping system shall be by lettered legend giving the name of the contents in full or abbreviated form.

2. Arrows shall be used to indicate direction of flow.

3. Legends shall be applied close to valves or flanges and adjacent to changes in direction, branches, and where pipes pass through walls or floors; and at intervals on straight pipe runs sufficient for identification.

4. Identification shall be accomplished by stenciling or the use of markers.

B. Color Chart and Piping Identification:

Piping System	Sherwin Williams Color Number Reference	Color	Stencil Identification
Water, Chilled, Supply	866 (Rustoleum)	Marlin Blue	CWS
Water, Chilled, Return	866 (Rustoleum)	Marlin Blue	CWR
Water, Cold Domestic	BM 78-8-BXK-769	Dark Green	DOM CW
Water, Hot, Supply	BM 80-21-BW-1121	Yellow	HWS
Water, Hot, Return	BM 80-21-BW-1121	Yellow	HWR
Gas	BM 80-8-BX-957	Red	GAS
Supports, Hangers	--	Black	--

C. Visibility:

1. Attention shall be given to visibility with reference to pipe markings.

2. Where pipe lines are located above or below the normal line of vision, the lettering shall be placed below or above the horizontal centerline of the pipe.

D. Size of Legend Letters:

OUTSIDE DIAMETER OF INSULATION OR PIPE	LENGTH OF COLOR FIELD	SIZE OF LETTERS
3/4" - 1-1/4"	8"	1"
1-1/2" - 2"	8"	2"
2-1/2" - 6"	12"	3"
8" - 10"	24"	4"
Over 10"	32"	4"

E. Pipe Markers:

1. Semi-Rigid Plastic

a. Semi-rigid plastic (not pressure-sensitive) identification markers shall have (1) approved color-coded background, (2) proper color of legend in relation to background color, (3) approved legend letter size, (4) approved marker length, and (5) direction of flow arrows.

b. Snap-around markers shall be used on outside diameters of 3/4" thru 5-7/8". These markers shall be custom formed to snap-on and completely encircle the pipe with a substantial overlap.

c. Strap-around markers shall be used on outside diameters of 6" and larger.

Markers shall be secured with stainless steel spring fasteners. Non-metallic fasteners shall be used where specifically directed.

d. For pipes with outside diameter under 3/4" (too small for color bands and legends), brass identification shall be used at specified locations.

e. Markers shall be covered and all printing shall be sealed beneath tough, clear outdoor grade acrylic plastic. Markers shall resist weather; repel dirt, abrasion and grease; as well as withstand acid, chemical and other corrosive conditions which are frequently encountered.

f. Markers shall be suitable for -40^{o}F to +180^{o}F operating range. On lines exposed to a temperature above 180^{o}F, markers shall be placed over insulation (not on bare pipe).

g. Markers shall be Setmark Pipemarkers as manufactured by Seton; or equal by listed acceptable manufacturers.

2.3 IDENTIFICATION NAMEPLATES:

A. Plastic Nameplates:

1. Nameplates shall be 1/16" thick satin-surfaced plastic material with beveled edges and engraved letters.

2. Each plate shall be drilled with two mounting holes sized for 3/8" No. 3 round headed or 3/8" No. 4 sheet metal screws. Plates shall be furnished with mounting screws. When scheduled or designated, plates shall be furnished undrilled.

3. Plates shall have black letters on white background. Letters shall be 3/16" high, minimum.

4. Plates shall be Setonply style 2060 as manufactured by Seton; or equal by listed acceptable manufacturer.

B. Aluminum Nameplates:

1. Nameplates shall be 0.020" flexible aluminum material with engraved letters.

2. Each plate shall be drilled with two mounting holes sized for 3/8" No. 3 round headed or 3/8" No. 4 sheet metal screws. Plates shall be furnished with mounting screws.

3. Plates shall have aluminum letters on a black enamel background.

4. Plates shall be style 2065 as manufactured by Seton; or equal by listed acceptable manufacturer.

2.4 UNDERGROUND WARNING TAPES:

A. Polyethylene Tape:

1. Polyethylene tape shall be heavy gauge 0.004" polyethylene film at a minimum width of 6".

2. Tapes shall be selected by color code to match the type of utility buried below.

3. Tapes shall be style 210 as manufactured by Seton; or equal by listed acceptable manufacturer.

B. Metallic Detection Tape:

1. Metallic detection tape shall be heavy gauge 0.004 thick with a minimum width of 6".

2. Tapes shall be selected by color code to match the type of utility buried below.

3. Tapes shall be style MLT as manufactured by Seton; or equal by listed acceptable manufacturer.

2.5 ELECTRICAL IDENTIFICATION:

A. Controls Conduit:

1. Semi-rigid plastic (not pressure-sensitive) identification markers shall have (1) approved color-coded background, (2) proper color of legend in relation to background color, (3) approved legend letter size, and (4) approved marker length.

2. Snap-around markers shall be used on a cable or conduit diameter of 3/4" to 5-7/8". These markers shall be custom formed to snap-on and completely encircle the pipe with a substantial overlap.

3. Markers shall be covered and all printing shall be sealed beneath tough, clear outdoor grade acrylic plastic. Markers shall resist weather; repel dirt, abrasion and grease; as well as withstand acid, chemical and other corrosive conditions which are frequently encountered.

4. Markers shall be suitable -40^{o}F to +180^{o}F operating range.

5. Markers shall be style ESPEC as manufactured by Seton; or equal by listed acceptable manufacturer.

B. Electrical Conduit: Electrical conduit identification that may be installed under the mechanical contract shall comply with paragraph 2.5A above.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with manufacturer's instructions for stencil painting.

C. Refer to Division 9 - Painting for preparation requirements of all surfaces.

3.2 INSTALLATION:

A. Pipe Installation:

1. Identify all piping systems, concealed and exposed, with plastic pipe markers or stencil and coating. Refer to piping systems specifications 15060SB for specific application requirements.

2. Locate pipe markers, stencils, or identification tags as follows:

a. Adjacent to each valve and fitting
b. At each branch and riser take off
c. At each pipe passage through walls, floors or ceilings
d. On all straight pipe runs every 25 feet.
e. At each passage to underground
f. At each item of equipment

3. Identify service, flow direction and pressure of all piping systems.

4. Install all identification in clear view and align for maximum visibility.

B. Equipment Identification:

1. Identify all the following equipment with screw mounted plastic nameplates:

a. Air Handling Units
b. Fans
c. Pumps
d. Boilers
e. Unit Heaters
f. Terminal Units

C. Ductwork Identification:

1. Identify all externally insulated ductwork systems with adhesive mounted plastic nameplates.

2. Identify as to fan/air handling unit number and area served.

3. Locate identification as follows:

a. At each item of equipment
b. At each side of penetration of structure or enclosure
c. At each control device
d. At each obstruction

4. Provide identification at or on each duct access door identifying item or items behind door, such as smoke detector, fire damper, smoke damper, control damper (O.A. for example), etc.

D. Underground Utilities:

1. Underground warning and metallic detection tapes shall be installed a maximum of 6" below grade, directly above buried pipe.

2. Metallic pipes shall have polyethylene warning tape.

3. Non-metallic pipes shall have metallic detection tape.

E. Electrical/Controls Identification:

1. Identify all control panels and devices/components outside panels with screw mounted plastic nameplates. For small devices, nameplates may be fastened to the mounting location directly above or below the device.

2. All controls conduit shall be identified with snap-around electrical markers. Markers shall say "CONTROLS" and indicate the line voltage contained in the conduit. Pneumatic lines contained in conduit shall say "CONTROLS-AIR" for identification.

3. Locate conduit identification as follows:

a. At each item of equipment
b. At each side of penetration of structure or enclosure
c. At each control device
d. On all straight conduit runs every 25 feet
e. At each passage to underground

F. Miscellaneous: Provide screw mounted nameplates on access doors in all building construction identifying items behind door, such as valves, controls, equipment, etc.

END OF SECTION 15035B

SECTION 15042B - TESTS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 REFERENCES: (Latest edition for listed references shall apply.)

A. ASHRAE Handbook - Fundamentals (latest edition): Chpt. 7 - "Sound and Vibration Fundamentals", and Chpt. 13 - "Measurement and Instruments".

B. ASHRAE Handbook - 1991 HVAC Applications: Chpt. 34 - "Testing, Adjusting, and Balancing".

C. ASHRAE Standard 111-1988: "Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems".

D. AABC - "National Standards for Total System Balance, 4th edition".

E. NEBB - "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".

F. SMACNA - "HVAC Systems - Testing, Adjusting & Balancing"

G. SMACNA - "HVAC Air Duct Leakage Test Manual"

H. SMACNA - "HVAC Duct Construction Standards - Metal and Flexible"

1.3 SUBMITTAL REQUIREMENTS:

A. Submit four (4) typed copies of proposed test procedures for approval in accordance with shop drawing requirements of Section 15010B - Mechanical General Provisions. Include description of procedures, instruments and equipment to be used, catalog data on instrumentation, planned manpower required, and proposed schedule. Provide this information for each type of test, and for each system to be tested.

B. Submit four (4) typed copies of test schedules of readings taken during testing and balancing operations, indicating the required reading, the first reading taken, and the final balance reading for the items listed in Part 3 - Execution, of this section in accordance with shop drawing requirements of Section 15010B - Mechanical General Provisions. Readings shall be taken with clean operating strainers and filters in place, but with start-up strainers removed.

C. Submit instrument calibration report along with the test schedules of readings taken during testing and balancing operations.

D. Submit Component Deficiency Report(s) as required to provide information helpful in determining the cause of the problem(s) and to provide feedback to the equipment manufacturer, designer, or installer. Submit such reports as soon as the problem becomes evident, and, where practical, provide recommendations for correcting the apparent system component failure. Furnish documentation of confirming test data and observations as required to substantiate the reported problems.

E. All information shall be assembled in a three-ring binder with index tabs to identify each item of major equipment and each system.

1.4 SCOPE OF WORK:

A. SYSTEM PREPARATION, START-UP, INITIAL TESTING AND PLACING IN SERVICE shall be performed by the Mechanical Contractor. The Mechanical Contractor shall be responsible for performing initial equipment and system checks and system start-up in order to prepare the system(s) for testing, adjusting, and balancing. The Mechanical Contractor shall furnish specific project information to the TAB Contractor, including, but not limited to, the following: Two (2) sets of all submittal data, complete shop drawings, duct and pipe

fabrication or layout drawings, contract drawings, project specifications, controls system(s) shop drawings, and initial system testing reports for use by the TAB Contractor.

B. SYSTEM TESTING, ADJUSTING, AND BALANCING (TAB) shall be performed by an independent TAB Contractor certified in performing TAB services, have trained in-house staff and have certified test equipment for performing Testing, Adjusting, and Balancing in accordance with appropriate sections of the AABC or NEBB standards. Furthermore, the independent TAB Contractor shall demonstrate that they have been providing TAB services on projects for the previous five (5) consecutive years that are similar in size and scope.

C. The independent TAB Contractor shall test, adjust and balance all systems until design function and operation are achieved. All work shall be performed in strict accordance with appropriate sections of the AABC or NEBB Standards, the ASHRAE Handbooks, and these Specifications. The TAB Contractor shall perform a pre-construction review of the Contract Documents in order to become familiar with the project and advise the Mechanical Contractor regarding potential problems that may impact TAB services. The TAB Contractor shall also be available to observe construction progress to identify and minimize TAB or operation problems, witness and certify Contractor's leak tests and manufacturer's performance tests as required. The TAB Contractor shall participate in the instruction and training of the Owner's operating personnel. The TAB Contractor shall correct any deficiencies for a period of one year following substantial completion and Owner acceptance of final balancing reports.

1.5 TESTING, ADJUSTING AND BALANCING (GENERAL):

A. Testing Contractor shall test, adjust and balance all systems until design function and operation are achieved.

B. Testing Contractor shall demonstrate performance of design function and operation for each system to Owner's representative.

C. Testing, adjusting and balancing shall be performed in accordance with the recommended procedures of the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB).

D. Perform testing specified in this section in the presence of the Owner's authorized representative. Local or state authorities having jurisdiction shall be given due notice of the tests as may be required by them, and acceptance of the work by the Owner's representative will be contingent upon acceptance by the public authority.

E. All system equipment shall be inspected, adjusted, and tested after installation. Adjustments shall be made and tests shall be repeated as often as necessary to insure that the equipment operates as specified.

F. Furnish all necessary equipment and assume all costs involved to perform all testing and balancing.

G. Tests of piping systems shall be conducted before connections to equipment are made, and before piping is insulated and/or concealed.

H. Systems found to have leaks shall be retested after leaks have been repaired.

I. Duct systems shall be tested under two (2) times the normal fan pressure with all air handling equipment, connecting ductwork, dampers, accessories and air outlet and inlet taps in place. Cover securely with plastic.

J. Balancing of each system shall not be done until the system has been completed and is fully operational.

K. Take all balancing readings with clean strainers and filters in place.

L. Instruments shall be calibrated prior to balancing. Types, serial numbers, and dates of calibration of all instruments shall be listed in the final balance reports.

M. After cleaning and testing of individual equipment items, test each system to determine that

all items perform as integral parts of the system. Make corrections and adjustments to produce the specified conditions.

N. The Contractor shall make any changes in pulleys, belts, motors, dampers and valves, and add any dampers and valves, as required for achieving correct air and water balancing.

O. Contractor shall maintain records of all inspections and tests performed on all systems. Records shall indicate which systems were tested, date of test, test witness(es), test conditions (be specific), test pressure and duration, test results, weather conditions, visual inspections, percent of system installation completed at time of test, specific test observations, and pertinent statements for the purpose of qualifying results or observations and number of tests required to achieve a successful test.

1.6 INSTRUMENTS:

A. The following instruments shall be furnished by the TAB Contractor for the purpose of performing systems testing and adjusting as specified in this section. Instruments required shall include, but not be limited to, the following:

1. Electrical: Digital volt, ohm, clamp-on amp, 1/2% accuracy
Digital Wattmeter

2. Air: Alnor velometer (optional if Shortridge Velprobe is used)
Micromanometer - Shortridge electronic with velocity probe and grid.
8", 18", 36" and 60" ASME pitot tubes
1/4" oil filled manometer (0-1" inclined)
Shortridge or Alnor balancing cones
Aspirating smoke generator
Pressure fan for leak testing
Superior Smoke bombs

3. RPM: Stroboscope: Digital - 1% + RPM accuracy
Digital tachometer: 1% + RPM accuracy

4. Water: -30" Hg to 60 psi pressure gauge 1/2% accuracy
0 to 200 psi pressure gauge 1/2% accuracy
0 to 36" Hg manometer
0-200' digital differential pressure meter

5. Temperature: Digital thermometer $1/10^{o}$ resolution, 1% accuracy
Surface and immersion probes for thermometer
Wet-bulb wicks and fans

6. Thermometer: 30 to 120^{o} 0.2^{o} 16" mercury

7. Air Quality: CO_2 analyzer

B. All meters shall be checked and calibrated with primary instruments prior to beginning any tests on this project. Voltmeters and other instruments that cannot be checked shall be laboratory calibrated at reasonable intervals of not more than one year. Magnehelic or dial type differential pressure gauges may be used only for preliminary or non-certified work within their ranges, after calibration using fluid filled manometers.

PART 2 - PRODUCTS

Not Applicable.

PART 3 - EXECUTION

3.1 PIPING TESTS: (Start-up and Placing in Service)

A. Test all new water piping systems with a hydrostatic pressure test at 150 psig or 1-1/2 times

operating pressure, whichever is greater, measured at the lowest point in the system, for a period of twenty-four (24) hours without pressure drop, other than that due to temperature changes.

B. Perform hammer test on each welded joint while under test pressure.

C. Repair all leaks and repeat test until specifications are met.

D. Water piping systems shall be placed in service with all normally open valves at full open position. Close coil bypass balancing cocks, clean all strainers, blow-down all drains, flush systems and clean out piping, and verify that water system chemical treatment is in service. Water pipe system cleaning with specified cleaning chemicals shall be completed. Verify proper pump rotation and that expansion tanks are not air-bound. Check all system air vents and determine that all high points are properly bled, operating freely, and not leaking. Verify that all specified flow sensors, thermometers or thermo-wells are in place, pressure gauges or gauge cocks are in place, and all required test plugs are installed.

3.2 DUCTWORK AND AIR HANDLING EQUIPMENT TESTS: (Start-up and Placing in Service)

A. Leak test all duct systems as work progresses in accordance with the SMACNA Manual "High Pressure Duct Construction Standards". Smoke test the entire system if the leaks are greater than one percent (1%) for high pressure or five percent (5%) for low pressure systems. Seal all duct joints with specified sealants. Leak test all air handling units, A/C units, VAV boxes, plenums, coil casings, filter boxes, and accessories and the connections to the ductwork systems. Verify that all access doors and panels are gasketed and have operable latches. Outlets or taps shall be covered with plastic during testing.

B. Verify that terminal units, such as VAV boxes, are operating properly. Coordinate testing, adjusting and balancing effort with the Controls Contractor to verify that damper maximum and minimum settings provide the CFM quantities as scheduled. Confirm that dampers open and close in response to the controlling thermostat.

C. Coordinate testing of the air handling systems with the Controls Contractor to obtain performance in accordance with the airflows scheduled on the Drawings.

D. Verify that each air handling system fan equipped with a variable speed drive, when the drive is bypassed (maximum rpm) that the fan does not exceed maximum CFM quantities as scheduled on the Drawings. Verify that the motor current draw does not exceed 95% of the nameplate rating.

E. Adjust belts and align drives for all rotating equipment. Lubricate bearings, dampers, etc., and check systems for excessive vibration and noise levels. Make adjustments necessary to prepare systems for final testing and balancing.

3.3 ADJUSTING AND BALANCING:

A. In cooperation with the Mechanical Contractor, the Controls Contractor, and Owner's representative, set adjustment of controls to operate as specified.

B. Piping Systems:

1. Adjust balancing valves to provide the specified liquid flows for each system and each system component. Measure flow at each balancing valve using flow versus pressure chart and liquid, electronic, or dial type manometer recommended by valve manufacturer.

2. Balance each individual chilled water and hot water coil.

3. After making adjustments to coils and valves (where installed), retest settings at pumps and equipment. Re-adjust if required.

4. Upon completion of flow readings and coil adjustments, and after water balance is complete, permanently scribe or punch mark all balancing valves, cocks, and fittings so that they can be restored to their correct position if disturbed.

5. Provide any pressure taps, thermometer wells, balancing valves, balancing cocks, fittings, and the like required for water balance.

6. If flow measuring devices are not specified for each coil, install temporary pressure gages on inlet and outlet of each coil at time of balancing.

C. Ductwork Systems:

1. Adjust fan speeds, duct systems and components to provide air quantities within + 10 percent of specified requirements under minimum and maximum flow conditions at each air inlet, outlet and variable air volume terminal unit.

2. Measure air quantities in main and branch ducts by traversing cross sectional area of duct with pitot tube. Ducts having minimum velocities of 1000 feet per minute or more shall be measured with inclined manometers (draft gage) or magnehelic gages, ducts having velocities of less than 1000 feet per minute shall be measured with micromanometers, hook gages, or similar low pressure instruments. Openings in ducts for pitot tube insertion shall be accomplished by installation of instrument ports. When not in use, ports shall be sealed with plastic "snap-plugs". Diffuser, grille, and register air quantities shall be determined by direct reading velocity meters.

3. Obtain design air quantities in main ducts by adjusting fan speeds. Then adjust branch duct air quantities by volume or splitter dampers.

4. Adjust minimum and maximum flow setpoint at each variable air volume terminal unit using methods and instruments recommended by terminal unit manufacturers.

5. Adjust extractors at supply grilles and branch ducts. Opposed blade dampers at diffusers and registers may be used to balance air quantities, providing final adjustments do not produce objectionable drafts or sound levels. Final air quantities shall be within 10 percent of design requirements.

6. In cooperation with the Control Contractor's representative, set adjustment of automatically operated dampers and valves to operate as specified.

7. After testing and adjusting branch ducts, terminal units, grilles, and the like, retest main duct air quantities. Re-adjust if required.

8. Permanently and legibly scribe, punch, or paint mark dampers after air balance is complete to enable them to be restored to their correct position if disturbed at any time.

9. Test fire dampers and smoke dampers to prove that they open and close properly.

D. Operating Controls and Safeties: Adjust and record set points of all control valves, dampers, controls and safeties for each equipment item, such as boilers, chillers, heat exchangers, coils, pumps, fans, and the like, and for each system. Coordinate with the Controls Contractor as required. Provide list showing:

1. System designation
2. Location of device
3. Designation of valve, damper, control or safety
4. Type
5. Function
6. Setting

3.4 TEST SCHEDULES: Provide the following data as required in Part 1 - General of this section. For each test, record the outside air temperature and humidity during the actual test. List the specified design data, first test reading taken, and final balance reading for each measurement.

A. Title/Cover Page:

1. Company name
2. Company address

3. Company telephone number
4. Project name
5. Project location
6. Project Architect
7. Project Engineer
8. Project Contractor

B. Instrument List:

1. Instrument
2. Manufacturer
3. Model
4. Serial number
5. Range
6. Calibration date

C. Pump Data:

1. Pump designation
2. Manufacturer, model and serial number
3. Size and impeller diameter
4. Type drive
5. Motor hp, volts, cycles, phase, service factor and F.L. amps (nameplate)
6. Design conditions:

    a. GPM
    b. Head
    c. RPM
    d. BHP

7. Field tests:

    a. Discharge pressure (full flow and no flow)
    b. Suction pressure (full flow and no flow)
    c. Operating head
    d. No load amps
    e. Full flow amps
    f. No flow amps
    g. Calculated bhp

D. Heat Transfer Equipment Data:

1. Chilled water coils:

    a. Manufacturer, model and serial number
    b. Element designation
    c. Size and type
    d. Specified conditions
    e. Flow rate, GPM
    f. Face velocity, FPM
    g. Entering and leaving water temperatures, Deg. F
    h. Entering and leaving air dry and wet bulb temperatures, Deg. F
    i. Pressure drop, feet of water
    j. Pressure drop-air, in. wg.
    k. Calculate BTU/Hour for both fluid and air

2. Unit heaters (hot water):

    a. Designation
    b. Manufacturer, model and serial number
    c. Size
    d. Specified conditions
    e. Fan speed, RPM
    f. Air flow rate, CFM
    g. Water flow rate, GPM

h. Water temperature, in & out, Deg. F

3. Circulating water distribution (each system - all control valves open):

a. Flow rate, GPM
b. Supply water temperature each zone, Deg. F
c. Return water temperature each zone, Deg. F

4. Hot water coils: (AHU coils)

a. Manufacturer, model and serial number
b. Element designation
c. Size and type
d. Specified conditions
e. Face velocity, FPM
f. Entering and leaving air temperatures, Deg. F
g. Entering and leaving water temperatures, Deg. F
h. Pressure drop-air, in. wg.
i. Hot water flow rate, gpm.
j. Pressure drop, feet of water

E. Air Balance Test Data:

1. Fan name plate data:

a. Unit designation
b. Manufacturer, model and serial number
c. Size
d. Arrangement, discharge, class
e. Motor, HP, volts, phases, cycles, full load amps

2. Design conditions:

a. CFM
b. Static pressure, inches of water
c. CFM outside air at minimum outside air
d. Inlet, outlet and outdoor air dry and wet bulb temperatures, Deg. F

3. Field test results (full load and minimum load for variable flow equipment):

a. CFM
b. Suction and discharge static pressure, inches of water
c. Inlet and outlet air dry bulb temperatures, Deg. F
d. Fan, RPM
e. Fan motor operating, volts and amps each phase

4. Velocity tests for main and branch ducts and fresh air intake duct:

a. Duct location and designation
b. Duct size
c. Static pressure
d. Duct average velocity, FPM
e. Total air quantity, CFM

5. VAV terminal units:

a. Designation
b. Location
c. Manufacturer, model, and serial number
d. Size
e. Fan nameplate data
f. Maximum air flow setting, CFM
g. Minimum air flow setting, CFM
h. Entering air temperature, Deg. F
i. Leaving air temperature, Deg. F

j. Type controls
k. Pressure dependent or independent
l. Entering and leaving air static pressure and velocity sensor differential pressure at max. and min. flow, inches water

6. Individual diffusers, registers, and grilles:

a. Diffuser, register, or grille identification as to location, area, and system
b. Manufacturer, type and size
c. Required and resultant test quantities, CFM
d. Deflector and/or diffuser core setting
e. Discharge pattern setting, degrees and direction (Note: All diffusers, grilles, and registers shall have their deflection and trim dampers adjusted to minimize drafts and noise.)

7. Duct accessories:

a. Test fire dampers, smoke dampers, and combination fire and smoke dampers to prove that they open and close properly.

b. Test control dampers to prove that they open and close properly, and verify all max. and min. settings.

G. Vibration isolators:

1. Verify that isolators are properly installed and are not "bottomed out" or short-circuited by improper contact.

2. Document potential isolator problems for resolution by the Contractor.

END OF SECTION 15042B

SECTION 15045B - MOTORS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 REFERENCES:

A. AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
B. AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
C. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
D. ANSI/NEMA MG 1 - Motors and Generators.
E. ANSI/NFPA 70 - National Electrical Code.
F. North Carolina State Building Code, Volume X - Energy.

1.3 SUBMITTALS:

A. Submit product data under provisions of Section 15010B, Shop Drawings.

B. Submit test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.

C. Submit manufacturer's installation instructions.

1.4 OPERATION AND MAINTENANCE DATA:

A. Submit operation and maintenance data under provisions of Section 15010B.

B. Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.5 QUALIFICATIONS: Manufacturer: Company specializing in manufacture of electric motors for industrial use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.

1.6 REGULATORY REQUIREMENTS:

A. Conform to applicable electrical code.

B. Conform to local energy code.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Deliver products to site and store under provisions of Section 15010B.

B. Contractor is to protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.8 WARRANTY: Contractor shall provide one year warranty from date of final inspection and acceptance under provisions of Section 15010B for all motors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS (MOTORS TO 3.0 HORSEPOWER):

A. Baldor Electric
B. General Electric
C. Lincoln Electric
D. Reliance Electric
E. Magnetek (Century)
F. Marathon

G. Motors furnished as proprietary selections to equipment manufacturers

2.2 MANUFACTURERS (PREMIUM EFFICIENCY MOTORS 3.0 HP AND LARGER):

A. Baldor Super E Series
B. General Electric Energy Saver Series
C. Lincoln Electric Energy Efficient Series
D. Reliance XE Series
E. Magnetek (Century) E-Plus III
F. Substitutions: Under provisions of Section 15010B, Substitutions.

2.3 GENERAL CONSTRUCTION AND REQUIREMENTS:

A. Electrical Service: Refer to equipment specification sections, and schedules on Drawings for required electrical characteristics.

B. Motors: Designed for continuous operation in 40 degrees C environment, and for temperature rise in accordance with ANSI/NEMA MG 1 limits for insulation class, Service Factor, and motor enclosure type.

C. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor, efficiency.

D. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.4 SINGLE PHASE POWER - SPLIT PHASE MOTORS:

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

D. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

E. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.5 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS:

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.6 SINGLE PHASE POWER - CAPACITOR START MOTORS:

A. Starting Torque: Three times full load torque.

B. Starting Current: Less than five times full load current.

C. Pull-up Torque: Up to 350 percent of full load torque.

D. Breakdown Torque: Approximately 250 percent of full load torque.

E. Motors: Capacitor in series with starting winding; capacitor- start/capacitor-run motors shall have two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated ball bearings.

G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.7 THREE PHASE POWER - SQUIRREL CAGE MOTORS:

A. Starting Torque: Between one and one and one-half times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Conform to ANSI/NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data.

G. Motor Frames: NEMA standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

I. Sound Power Levels: To ANSI/NEMA MG 1.

J. Part Winding Start (Where Indicated): Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.

K. Nominal Efficiency: Meet or exceed values in Schedules at full load and rated voltage when tested in accordance with ANSI/IEEE 112.

L. Nominal Power Factor: Meet values in Schedules at full load and rated voltage within + 5% (5 percent) when tested in accordance with ANSI/IEEE 112.

PART 3 - EXECUTION

3.1 APPLICATION:

A. Motors drawing less than 250 Watts and intended for intermittent service may be proprietary to equipment manufacturer and need not conform to these Specifications.

B. Motors shall be open drip-proof type, except where specifically noted otherwise.

C. Motors shall meet the requirements of paragraph 401.2 of the North Carolina State Building Code, Volume X - Energy.

D. Single phase motors for shaft mounted fans or blowers shall be permanent split capacitor type.

E. Motors located in exterior locations shall be totally enclosed type.

F. Unless specifically scheduled otherwise, motors 3.0 horsepower and larger shall be premium energy efficient type and shall have minimum efficiencies in accordance with the following tables:

Motor	ODP Enclosure			TEFC Enclosure		
HP	2-Pole	4-Pole	6-Pole	2-Pole	4-Pole	6-Pole
3.0	-	87.5	89.5	88.5	88.5	89.5
5.0	87.5	88.5	89.5	88.5	88.5	89.5
7.5	88.5	89.5	90.2	90.2	90.2	90.2
10	90.2	90.2	91.0	91.0	90.2	91.0
15	90.2	91.7	91.0	91.7	92.4	92.4
20	91.7	92.4	91.7	91.7	92.4	92.4
25	92.4	93.0	92.4	93.0	93.6	93.0
30	93.0	93.0	93.0	93.0	93.6	93.6
40	93.6	94.1	93.6	94.1	94.1	94.1
50	94.1	94.1	93.6	94.1	94.5	94.1
60	94.5	95.0	94.5	95.0	95.0	95.0
75	94.5	95.0	95.0	95.0	95.0	95.0
100	94.5	95.4	95.0	95.0	95.4	95.0
125	95.0	95.4	95.0	95.4	95.8	95.4
150	95.4	95.8	95.4	96.2	96.2	96.2
200	95.4	95.8	95.4	96.2	96.2	96.2

3.2 NEMA OPEN MOTOR SERVICE FACTORS:

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150	1.15	1.15	1.15	1.15

END OF SECTION 15045B

SECTION 15060B - PIPE, PIPE FITTINGS, AND VALVES

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 DRAWINGS: Drawings show the approximate routing of piping; however, execution of the work shall be coordinated more precisely as described in Part 3 of this section.

1.3 REFERENCES:

A. ASTM B 828 - "Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings".

B. ASTM B 813 - "Standard Specification for Liquid Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube".

1.4 DEFINITIONS:

A. Design pressure of a zone of piping is the maximum pressure that can be predicted to occur in that zone, from an analysis of Drawings. Design pressure is not normally indicated on Drawings. Consult Owner's representative if the design pressure for a particular zone is in question.

B. Flanging refers to the roll-back operation to form a flange using the pipe wall. It shall not be construed as the welding of a flange fitting to the end of a pipe, the coupling of pipes, or the coupling of pipes and fittings by means of flange fittings.

C. Furnace butt welded (or butt welded) pipe refers to a particular pipe manufacturing process. The term shall not be construed as the joining of steel pipe by means of a butt weld, or as the suitability of a particular type of pipe for butt welding.

D. Outside shall mean 5 feet beyond the perimeter of buildings.

E. Inside shall mean inside buildings and within 5 feet of the perimeter of buildings, except that footing drains are excluded.

F. Protected pipe refers to the coating or covering of an uninsulated pipe to make it suitable for exposure to outside weather, for direct burial in dry or wet earth, or for submarine installations in direct contact with water.

1.5 QUALITY ASSURANCE:

A. Welding procedures and each welder shall be qualified in accordance with ASME Boiler and Pressure Vessel Code (Section IX), latest edition, or shall have proof of test satisfactory to Owner's representative.

B. Each welder's certificate shall be made available at the work site and available to the Owner's representative upon request.

C. Each welder on the project shall be assigned a unique number traceable to him by name. Each individual welded joint shall have the number of the responsible welder legibly stamped into the surface of a polished place on the pipe adjacent to the weld.

1.6 SUBMITTALS: Submit shop drawings in accordance with Section 15010B - Mechanical General Provisions:

A. Various piping material systems are specified for this project (e.g. CP/1, CS/1, CS/2, and the like). Refer to Specification Section 15060SB. For each piping material system listed, provide the following:

1. Description of piping material(s) to be provided for each system

2. Description of fittings to be provided for each system

3. Description of flanges to be provided for each system

4. Manufacturer's data-sheets on valves -- indicate on individual valve data-sheets which material system(s) the valve will be used in. Provide construction and materials compliance data, dimensional data, and Country of origin for each valve or valve specialty type.

5. Manufacturer's data-sheet on strainers -- indicate on individual strainer data-sheets which material system(s) the strainer will be used in.

6. Manufacturer's data-sheets on Soldering/Brazing materials (to include composition, solidus, and liquid temperatures) -- indicate on individual data sheets which material system(s) the soldering materials will be used in.

B. Manufacturer's Product Data Sheets for the alkaline cleaner to be used in cleaning both HW and CHW piping systems.

C. Welder's Qualifications

PART 2 - PRODUCTS

2.1 PIPE, PIPE FITTINGS, VALVES AND ACCESSORIES: Shall be as listed in the Piping Schedules at the end of this specification section. All pipe, pipe fittings, valves and installation accessories shall be manufactured in the USA.

2.2 PIPE FITTINGS: Welded, flanged, screwed, brazed, or soldered fittings for ferrous or copper piping shall be as manufactured by Crane, Nibco, Walworth, Stockham, Grinnell, Mueller, Weldbend, Tube Turns, or Chase and shall meet the requirements of the standards specified in the Piping Schedules. Threadolets and weldolets shall be Boney Forge, or equal.

2.3 VALVES: Acceptable valve manufacturers, subject to compliance with the Specifications, shall include the following:

A. Gate Valves: Crane, Grinnell, Jenkins, Kennedy, Lunkenheimer, Milwaukee, Nibco, Stockham, U.S. Pipe, and Watts.

B. Ball Valves: Conbraco (Apollo), Crane, Grinnell, Milwaukee, Nibco, Stockham, and Watts.

C. Butterfly Valves: Crane, Demco, DeZurik, Grinnell, Milwaukee, Nibco, and Stockham. (Note: Thin profile, high flow capacity disc required. See Specifications.)

D. Globe Valves: Crane, Grinnell, Jenkins, Lunkenheimer, Milwaukee, and Stockham.

E. Check Valves: Crane, Grinnell, Lunkenheimer, Milwaukee, and Stockham.

2.4 STRAINERS: Acceptable strainer manufacturers, 'Y'-type, subject to compliance with the Specifications, shall include the following: Muesco (Mueller Steam Specialty), Armstrong, Metraflex, Spriax-Sarco, and Watts.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION:

A. Prior to all piping work, carefully inspect the work by other trades and verify that all such work is complete to the point where the piping may be installed in accordance with these documents.

B. Prior to all piping work, carefully inspect all existing conditions to verify that the piping may be installed in accordance with these documents.

C. Follow the Drawings in layout work and check drawings of other trades to verify sufficient space to install piping.

D. Undimensioned Drawings are intended to indicate the general arrangement of piping systems and are not intended to convey precise locational information.

E. Coordinate with other trades to permit the work of all trades to be installed.

F. Coordinate the work to insure that supports, sleeves and inserts are positioned accurately along with other built-in items, before concrete pouring takes place, so as to reduce to an absolute minimum the necessity for cutting or patching at a later stage.

G. Offsets, fittings, and extra pipe necessary to avoid interference, or provide maximum headroom and space shall be furnished and installed without additional expense to the Owner.

H. If the piping is installed without coordinating with other trades and so as to cause interference with work of other trades, the necessary changes shall be made at no extra charge.

3.2 INSTALLATION:

A. Excessive cutting and similar operations likely to weaken a structure or support to facilitate piping installation will not be permitted.

B. Prevent trash and dirt from entering pipes, before, during, and after installation, taking care and implementing suitable control measures throughout the construction period. Temporarily plug pipe ends as construction progresses, and until final connections are made.

C. Run piping parallel to walls of building, adjacent piping, fencing and the like, unless otherwise indicated.

D. Where pipe is to be insulated, provide a clearance equal to the insulation thickness plus a minimum of 2 inches.

E. Piping shall be worked in place without springing or forcing, and so as to properly clear all openings and equipment.

F. Piping shall be installed to permit free expansion and contraction without damage to joints or supports.

G. Thermal expansion of pipe shall be provided for in accordance with good trade practices. Use swing joints, turns, expansion loops, or long offsets, anchors and guides, as necessary to allow for and control pipe movement in accordance with ANSI B31.1.

H. Piping connections to equipment shall be installed in such manner that no excessive stresses will be transferred from the piping system to the equipment either during construction or operation.

I. Steel members shall be installed as required to support and anchor pipelines. Supports, anchors, or stays which may deform or alter the shape of the piping, during or after installation, shall not be used.

J. All changes in size and direction shall be made with proper pipe fittings; no miter fittings or joints will be accepted without prior approval of the Owner's representative.

K. Notching of copper tubing or plastic piping for connections will not be permitted.

L. All piping shall be cleaned and blown out just before installation.

M. Provide globe, ball, or butterfly type valves for throttling or drain service.

N. Valves shall be installed with stems vertical, horizontal or inclined upward. Valves shall not

be arranged with stem below body.

O. Protect all water systems against freezing throughout the progress of the installation until final acceptance.

P. All water piping shall be protected in an approved manner from freezing at any future time under normal operating circumstances.

Q. All water piping shall be installed in such a manner that the entire system can be completely drained.

R. Protect pipes which are to receive a vapor barrier insulation from pipe hangers by using pipe saddles specifically designed for this purpose.

S. Closed Recirculating Systems: Do not install devices which allow gas or water to leak or which may encourage tampering with the closed-to-oxygen integrity of the system. Equip all closed system pumps with mechanical seals. Install manual (not automatic) air vents at the tops of all risers, at all high points, and at points that will tend to trap air, for the purpose of purging during initial fill and adjustment only. Do not pitch horizontal runs of closed system piping, unless specifically required on Drawings. Install runs of closed system piping to facilitate ganged hanging. Do not install piping in a manner that creates pockets unless specifically shown on the Drawings.

3.3 LAYOUT, CUTTING, AND FITTING UP:

A. Pipe and tubing shall be cut accurately to suit field conditions.

B. Pipe ends that are to be butt welded shall be beveled in accordance with ANSI B16.25.

C. Burrs shall be removed by reaming and other objectionable defects shall be removed by machining, chipping, or grinding.

D. Laterals ("Y" fittings) shall be used for branch connections in drainage piping, unless otherwise indicated.

3.4 CONCEALED PIPE:

A. In general, all pipe in finished spaces shall be run concealed in floors, walls, partitions and above ceilings. Under no circumstances shall gas piping be run in floors or walls or above concealed ceiling spaces.

B. Concealment and covering of pipe shall not be done until authorized by the Owner's representative, after proper tests have been made. This applies to all interior work and exterior work.

3.5 OPENINGS, SLEEVES & FLASHINGS:

A. Pipe sleeves shall be provided where pipes pass through walls, floors or partitions. Sleeves through floors shall be Schedule 40 steel pipe set flush with bottom of slab and shall extend approximately 1/2" above the finished floor. Sleeves through partitions shall be Schedule 40 steel pipe flush with both sides of walls or partitions, and coated with rust inhibitive paint. Sleeves passing through concrete or masonry walls shall be Schedule 40 steel pipe set flush with the wall on both sides.

B. Sleeves for insulated pipes shall be large enough to accommodate insulation and to permit expansion movement. Sleeves shall be 1" larger in dimension that the outside diameter of insulation. Insulation shall be continuous through sleeves.

C. Support pipe from building structure where pipe penetrates walls to prevent resting on building wall or skin.

D. Where pipes penetrate firewalls, fire partitions, or fire rated floors, provide U.L. approved firestop seal between pipe and pipe sleeve in accordance with Section 15090B, Supports, Anchors & Seals. Pack all other spaces between sleeves and insulation or pipe with

fiberglass to make airtight.

E. When available to meet the same objectives described above, prefabricated, preinsulated "Pipe Shields" will be acceptable for pipes passing through floors, exterior walls, fire walls and fire resistive walls and partitions.

3.6 WELDED JOINTS:

A. Welded joints between sections of pipe and between pipe and fittings shall be in strict compliance with ANSI B31.1, Chapter 5, Section 127.

B. Each welded joint shall be stamped with the individual welder's identification number. See Quality Assurance in Part 1 of this section.

C. Make joints in piping for all services tight and leakproof against the design pressure.

D. Peening of welded joints to correct leaks will not be permitted.

E. Carbon steel pipe welding shall be done by the manual metal arc process using coated electrodes or gas arc (GMAW) process. All socket welds shall be made by manual metal arc processes.

F. Heat Treatment of Welds: No preheating of carbon steel piping is required, except no welding shall be performed on metal colder than 32^{o}F.

G. Welding shall penetrate the full wall thickness of the pipe. Slag shall be cleaned from each weld layer and any serious defects removed before the next layer is applied. The completed weld shall be cleaned of slag.

H. Preparatory to final welding, the proper gap shall be maintained while tack welding the pipe and connections in position so that a proper gap is made for a full penetration weld.

I. Tack welds shall be of the same quality and made by the same process as the rest of the weld, or they shall be removed prior to completion of the weld.

J. Small, sound, tack welds which penetrate to the bottom of the welding grove may become a part of the finished weld. Tack welds lacking penetration are not acceptable and must be removed. Large tack welds which almost fill the welding groove are not acceptable and must be removed.

K. Branch connection joints shall be prepared so as to permit full penetration welds of a quality comparable to the circumferential welds in the same piping system.

L. Permanently welded-in back-up strips shall not be used.

3.7 SOLDERED JOINTS:

A. The procedure outlined in ASTM B 828 "Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings" shall be followed in making all soldered or brazed joints.

B. The flux used during the soldering or brazing procedure shall meet the requirements of ASTM B 813 "Standard Specification for Liquid Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube".

C. No solder or brazing materials shall be present on the job-site other than those which are specified in Section 15060SB.

D. Using an oxy-acetylene torch, apply heat to the joint being brazed. Minimum 15% silver brazing alloy shall be used when making copper to copper joints.

E. After brazing, allow the completed joint to cool naturally in accordance with the ASTM B 828 procedure. Shock-cooling the joint with water is prohibited. When cool, clean off any remaining flux residue with a wet rag.

F. Joints that leak shall be disassembled, cleaned, and made again. Applying additional solder to a leaking joints is prohibited.

3.8 THREADED JOINTS:

A. Piping specified to be joined by threading shall be cut square to accurate lengths, and after threading shall be reamed to remove burrs and to provide full flow diameter of pipe through the joint.

B. Threads shall be cut full, clean, and concentric with the outside of the pipe. Threads shall be in accordance with ANSI B2.1 for taper threads.

C. Remove excess thread cutting lubricant from the inside and outside of pipe.

D. Threaded joints shall be made leak-tight by use of a suitable joint compound or teflon tape for pipe threads. (No. 51 Permatex pipe joint compound or equal), except as otherwise required by attached Piping Schedules.

E. When assembled, not more than three threads shall be visible at any joint.

F. Make joints in piping systems tight and leakproof against design pressures.

G. Care shall be taken to avoid over-tightening of threaded joints and to avoid damaging the pipe exterior with the pipe wrench.

H. Backing off of made-up threaded joints to facilitate fit-up or alignment will not be permitted.

I. Repair leaks in screwed or flanged joints which cannot be eliminated by normal wrench tightening methods by remaking the joint. Caulking will not be allowed.

3.9 FLANGED JOINTS:

A. Flanges shall be permitted in sizes and for the maximum service ratings only as covered by the American National Standard B16.5. Where flanges larger than those covered by the ANSI Standard are required, they shall be submitted for approval at time of bid.

B. Carbon steel flanges shall not be back-faced or spot-faced below standard thicknesses.

C. Pipe in screwed flanges shall seal within 1/16" to 1/8" of face.

D. Flange bolt holes shall straddle vertical pipe center lines.

E. Bolts in flanged joints shall be drawn up to provide even and adequate pressure to seat the gaskets and to provide relatively uniform stresses in the bolts.

F. All flanged joints shall be made with new undamaged gaskets and bolting materials as specified in Piping Schedules in Section 15060SB.

G. Care shall be taken to assure that all gaskets are properly positioned prior to tightening of the bolts.

H. Care shall be taken to avoid over-torquing any bolts. Bolts and nuts which are over-torqued shall be replaced.

3.10 FITTINGS:

A. Reducers: Make changes in pipe size by using factory made reducers. Use eccentric reducers in horizontal gravity flow systems with the flat side on bottom. Bushings, victaulic reducing couplings and field made reducers will not be permitted.

B. Tees, weldolets, sockolets and threadolets, or factory made tee fittings, shall be used for branch connections when the diameter of the branch connection does not exceed 50% of the diameter of the main; otherwise, factory made tee fittings shall be used for tee connections.

C. Elbows shall be factory made long radius type.

D. Unions: Install unions on each side of all threaded special valves, threaded regulators and similar items, on one side of each threaded check valve and at all pieces of unflanged equipment, so that such equipment might be readily disconnected and removed. Unions shall not be placed in a location which will be inaccessible after completion of the work.

E. Gaskets: Assemble flanges with gaskets specified in Piping Schedules at the end of this section.

3.11 LEAK TESTING OF PIPING SYSTEMS: Perform leak tests according to the applicable paragraphs in Section 15042B - Tests.

3.12 CLEANING OF PIPING SYSTEMS: The interior surfaces of piping shall be smooth and entirely free from obstructions to flow. Clean the systems before connecting to equipment or other systems. Thoroughly clean all hot and chilled water piping systems using an alkaline cleaner, mixed in accordance with the manufacturer's recommendations. Where possible, heat the cleaning solution to approximately 160^{o}F and circulate for at least 24 hours in the system. When heat cannot be applied, circulate the cleaning solution for at least 48 hours. Afterwards, drain and flush entire system before refilling for final system start-up and operation.

3.13 CLEANING OF DOMESTIC WATER PIPING: System cleaning and sterilization of domestic water piping shall be performed by the Plumbing Contractor.

END OF SECTION 15060B

SECTION 15060SB - PIPING SCHEDULE - SERVICE & MATERIAL SYSTEM

I.D.	DESCRIPTION	OPERATING PSIG	^{o}F	MATERIAL SYSTEM	INSULATION SYSTEM	NOTES
CD	Condensate Drain	ATM.	45	CP/1	E	3,4,7
CHS	Chilled Water Supply (Above ground)	60	45	CS/1	E	3,7,9,10
CHR	Chilled Water Return (Above ground)	60	55	CS/1	D,E	3,7,9,10
D	Drain	ATM.	45-180	CP/1	-	2,3
G	Gas	5	70	CS/1,PL/1	-	3,5,6
HWS	Heating Water Supply (Above ground)	60	180	CP/1	B,C,G	1,3,8,9
HWR	Heating Water Return (Above ground)	60	160	CP/1	B,C,G	1,3,8,9

Notes:

1. Use CP/1 solder joint material system for piping at terminal unit hot water coils. See detail on Drawings.

2. Insulate as required by notes on Drawings, and as necessary to prevent a surface temperature above 120^{o}F (prevent burning personnel) or below 55^{o}F (prevent condensation).

3. Refer to Section 15035B for pipe painting and identification.

4. Insulation thickness on air conditioning condensate drain lines shall be 3/4" thick, regardless of pipe size.

5. Gas piping shall comply with the requirements of Section 15061B. It is the Contractor's option to provide either plastic piping or steel piping outside underground only. Aboveground gas piping shall be Material System CS/1.

6. Paint exposed gas piping yellow in accordance with ANSI standards.

7. A continuous vapor retarder and a continuous insulation thickness, including all joints, fittings, valves, equipment, and accessories is required and is extremely important to prevent condensation.

8. Contractor's option on insulation system.

9. Provide canvas jacket over insulation assembly in mechanical rooms (all basement areas and all attic areas). Refer to Specifications.

10. Provide all service jacket (ASJ) over insulation assembly in all areas, including areas to receive canvas jacket. ASJ shall be completely sealed to serve as primary vapor retarder.

PIPE INSULATION SCHEDULE (See Section 15250B - Insulation)

System	Description	Pipe Size	Insulation
A (100-160°F)	Molded glass fiber with all service jacket (ASJ). Continuous vapor retarder not required. Provide finish jacket as scheduled.	1" & Smaller*	1.0" Thick
		1-1/4" - 2"	1.0" Thick
		2-1/2" - 4"	1.5" Thick
		5" - 6"	1.5" Thick
		8" & Larger	1.5" Thick
	*Runouts less than 12 feet long to individual terminal equipment may have 0.75" thick insulation. If runout is greater than 12 feet long, entire length shall have 1.0" thick insulation.		
B (170-220°F)	Same as System A, except thicker insulation.	1" & Smaller*	1.0" Thick
		1-1/4" - 2"	1.5" Thick
		2-1/2" - 4"	2.0" Thick
		5" - 6"	2.0" Thick
		8" & Larger	2.0" Thick
	*Same as System A.		
C (170-220°F)	Calcium silicate. Provide finish jacket as scheduled.	1" & Smaller	1.5" Thick
		1-1/4" - 2"	1.5" Thick
		2-1/2" - 4"	2.0" Thick
		5" - 6"	2.5" Thick
		8" & Larger	3.0" Thick
D (35-70°F)	Polystyrene with vapor retarder all-service jacket. Continuous vapor retarder, including sealing of joints, seams, staples, and the like is required. Provide finish jacket as scheduled.	1" & Smaller	1.0" Thick
		1-1/4" - 2"	1.0" Thick
		2-1/2" - 4"	1.5" Thick
		5" - 6"	1.5" Thick
		8" & Larger	1.5" Thick
		*Note: Not Allowed in plenums in NC (fire/smoke 25/50 required).	
E (35-70°F)	Molded or sheet foamed plastic. Continuous vapor retarder, including sealing of joints, seams and the like is required. Provide finish jacket and/or finish as scheduled.	1" & Smaller	.75" Thick
		1-1/4" - 1-1/2"	1.0" Thick
		2" - 3"	1.0" Thick
		4" & Larger	1.0" Thick*
		*Note: Not Allowed 4" & larger in plenums in NC (fire/smoke of 25/50 required).	
F (35-70°F)	Cellular glass with factory applied vapor retarder all-service jacket. Seal jacket with 2-coat vapor retarder sealant. Smooth finish on finished jacket required. Continuous vapor retarder including sealing of joints, seams, and the like is required. Provide finish jacket as scheduled.	1" & Smaller	1.5" Thick
		1-1/4" - 2"	1.5" Thick
		2-1/2" - 4"	1.5" Thick
		5" - 6"	2.0" Thick
		Note: Minimum thickness 1.5" to avoid breakage because of brittle material.	
G (100-240°F) (Underground)	Cellular glass with all-service jacket. Continuous vapor retarder not required. Provide finish jacket as scheduled.	All Sizes	2.0" Thick

PIPING SCHEDULE - MATERIAL SYSTEM CP/1

Pressure Design 100 psig. Temperature Design 210°F.

ITEM	SIZES	MATERIALS
Pipe	ALL	ASTM B-88, Type L, Seamless, Hard Drawn Copper Tubing (above grade).
		ASTM B-88, Type K, Seamless, Hard Drawn or Soft Annealed Copper Tubing (below grade).
Fittings	ALL	ASTM B-75 and ANSI B16.22, Wrought Copper, Solder Joint, or ASTM B-62 and ANSI B16.18, Cast Brass, Solder Joint.
Flanges	ALL	ASTM B-62 and ANSI B16.18, Cast Brass, 125 lb., Flat Face, Socket Type Solder Joint.
Unions	1-1/4" & Larger	ASTM B-62 and ANSI B16.18, Cast Brass, Threaded Ends.
	1" & Smaller	ASTM B-62 and ANSI B16.18, Cast Brass, Solder Joint.
Valves, Gate	4" & Larger	Crane No. 465-1/2 Flanged 125# Cast Iron, OS&Y, Bronze Trim and Stem.
	3" & Smaller	Crane No. 428 Threaded End, or No. 1334 Solder End, Bronze, Rising-Stem, Screwed Bonnet, Solid Wedge Disc.
Valves, Globe	4" & Larger	Crane No. 351 Flanged 125# Cast Iron, OS&Y, Bronze Trim and Stem.
	3" & Smaller	Crane No. 1 Threaded End, No. 2 Angle Threaded End, or No. 1310 Solder End, Bronze, Screwed Bonnet, Composition Disc.
Valves, Check	4" & Larger	Crane No. 373 Flanged 125# Cast Iron, Swing Check, Bolted Top, Bronze Trim.
	3" & Smaller	Crane No. 37 Threaded End, or No. 1342 Solder End, Bronze, Swing Check, Screwed Cap, Bronze Disc.
Valves, Ball	2" & Smaller	Apollo 70-400 Series Bronze Solder Ends with Integral Union. (Use at equipment connections.)
	2" & Smaller	Apollo 70-200 Series Bronze Solder Ends (Use for general service and isolation valve.)
Strainers	4" & Larger	Mueller No. 751 Flanged 125# Cast Iron "Y" Type, Bolted Cover with Drain, Stainless Steel Screen.
	3" & Smaller	Mueller No. 351 Threaded End, or No. 353-1/2 Solder End, "Y" Type, Bronze, Screwed Drain, Stainless Steel Screen.

PIPING SCHEDULE - MATERIAL SYSTEM CP/1 - Continued

Pressure Design 100 psig. Temperature Design 210°F.

ITEM	SIZES	MATERIALS
Joints	Flanged	Garlock Full-Face Gasket
	Threaded	Commercial Grade Pipe Dope or Teflon Thread Tape.
	Solder	94/6 Tin-Silver (430°F solidus; 535°F liquidus). Stay-Brite 8 as manufactured by J.W. Harris or equivalent.
Studs & Nuts	ALL	ASTM A-307, Grade B, Zinc Plated Hex Head Machine Type.
Cleaning	ALL	Flush water systems with water until water runs clear from each system.

PIPING SCHEDULE - MATERIAL SYSTEM CS/1

Pressure Design 150 psig. Temperature Design 250°F.

ITEM	SIZES	MATERIALS
Pipe & Pipe Nipples	2-1/2" & Larger	ANSI/ASTM A-53, Grade B, Seamless or ERW, ANSI/ASME B31.1 and ANSI B36.1, Standard Weight*, Carbon Steel, Bevel Ends for Weld.
	2"	ANSI/ASTM A-53, Grade B, Seamless or ERW, ANSI/ASME B31.1 and ANSI B36.1, Standard Weight*, Carbon Steel, Threaded & Coupled, furnished with coupling for joint.
	1-1/2" & Smaller	Same as for 2", or ANSI/ASTM A-106, Grade B, Seamless, ANSI/ASME B31.1 and ANSI B36.1, Standard Weight, Carbon Steel, Threaded & Coupled, furnished with coupling for joint.
Fittings	2-1/2" & Larger	ANSI B16.9 and ANSI/ASTM A-234, WPB, Standard Weight, Carbon Steel, Butt-Weld.
	2" & Smaller	ANSI B16.3 and ANSI/ASTM A-197, 150 lb., Black Malleable Iron, Screwed.
Flanges	2-1/2" & Larger	ANSI B16.5 and ANSI/ASTM A-181, 150 lb., Carbon Steel, Weld-Neck or Slip-on, Raised Face Standard, Flat Face where necessary to match valves or equipment. Slip-on not allowed at valves or equipment.
Unions	2" & Smaller	ANSI B16.39 and ANSI/ASTM A-197, 300 lbs., Black Malleable Iron, Ground Joint, Brass Seat.
Valves	2-1/2" & Larger	Butterfly - Crane Quartermaster 44N Threaded Lug Type, EPDM Seat, Aluminum Bronze Disc. Note: Bolt flanges to lug valves from both sides so either side can be removed. Use proper length bolts. Check - Crane No. 147 Flanged Steel 150#, Swing Check, Bolted Top. Wafer Check - Mueller 101M-AP Wafer Type or 105M-AP Globe Type (use in discharge of pumps). Cast Iron 125# Body, Bronze Disc and Seat, Stainless Steel Spring.
Valves	2" & Smaller	Gate - Crane 431 Bronze, Rising Stem. Globe - Crane 14-1/2P Straight or 16-1/2P Angle Type, Bronze, Rising Stem. Check - Crane 137 Swing Check, Threaded End, Bronze, Screwed Cap, Bronze Disc. Ball - Apollo 70-100 Series Bronze, or use 70-300 Series to eliminate unions. May be used in place of Gate or Globe Valve.

* Unless noted otherwise in Piping Schedule.

PIPING SCHEDULE - MATERIAL SYSTEM CS/1 - Continued

Pressure Design 150 psig. Temperature Design 250°F.

ITEM	SIZES	MATERIALS
Valves	1/2" - 2" (gas service only)	Plug - Durco G432 Carbon Steel Body and Plug, class 150, screwed ends, asbestos free packing, loose handle type wrench.
	2-1/2" & up (gas service only)	Plug - Durco G411 Carbon Steel Body ad Plug, class 150, flanged ends, asbestos free packing, loose handle type wrench.
Butterfly Operator	8" & Larger	Manual Gear Operator-Crane G41.
	6" & Smaller	10 Position Thumbscrew Lock - Crane TL7 & TL10.
Strainers	2-1/2" & Larger	Mueller No. 751 Cast Iron 125 lb. Flanged "Y" Type, Bolted Cover with Drain, Stainless Steel Screen.
	2" & Smaller	Mueller No. 351 Threaded "Y" Type, Bronze, Screwed Drain, Stainless Steel Screen.
Joints	2-1/2" & Larger	Garlock Ring Gasket for Raised Face Flanges and Full Face Gasket for Flat Face Flanges. No asbestos allowed.
	2" & Smaller	Commercial Grade Pipe Dope or Teflon tape.
Studs & Nuts	ALL	ASTM A-307, Grade B, Hex Head Machine.
Cleaning	ALL	Flush with water until water runs clear from each system.
Valves, Flow Control & Balancing	3" & Smaller	ITT Bell & Gossett Circuit Setter Plus bronze threaded flow balancing valves rated 200 psig at 250°F, with calibrated nameplates, memory stop, and differential pressure ports with check valves and caps. Size for specified flow to be near midpoint of valve range. Equal valves by Armstrong or TACO will be acceptable.

END OF SECTION 16060SB

SECTION 15080B - HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 DRAWINGS: Drawings show the approximate location of piping and components. Flow and control diagrams indicate diagrammatic function.

1.3 SUBMITTALS: Submit the following in accordance with the requirements of Section 15010B, Submittal:

A. Drawings indicating components, assembly, dimensions, weights, required clearances, location and size of all field connections, pressure and temperature ratings, and performance criteria.

B. Product data indicating rating capacities, accessories, and performance criteria.

C. Pressure drop ratings versus flow for all triple duty valves and circuit setter balance valves.

D. Manufacturer's installation instructions.

E. Operation and Maintenance manuals to include manufacturer's descriptive literature, startup and operating instructions, maintenance procedures and parts lists.

1.4 SHIPPING TAG: Each unit shall be tagged at the factory with its specific location on the job, including building floor, system served, and unit designation shown on the Drawings.

1.5 NAMEPLATES: Provide nameplate or equipment tag on each unit as required by Section 15035B - Mechanical Identification.

1.6 QUALITY ASSURANCE: All products furnished under this Specification Section shall be asbestos-free.

1.7 WARRANTY: Unless noted otherwise, provide a one-year warranty from date of final acceptance under provisions of Section 15010B.

1.8 DELIVERY, STORAGE AND HANDLING:

A. Equipment shall be delivered to the site in accordance with the provisions of Section 15010B.

B. Equipment shall be stored and protected under the provisions of Section 15010B.

C. Store in clean, dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components and painted finish. Components damaged by weather, construction activities, or mishandling shall be replaced at the Contractor's expense.

PART 2 - PRODUCTS

2.1 AUTOMATIC FLOW-CONTROL VALVES: Gray-Iron body, factory set to maintain constant flow with + 5 percent over system pressure fluctuations, and equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case. Each valve shall have an identification tag attached by chain, and factory marked with the AHU identification, and flow rate.

A. Brass or ferrous-metal body designed for 200 psig at 250 degrees with corrosion resistant, tamperproof, self-cleaning, piston-spring assembly easily removable for inspection or replacement.

B. Manufacturer: Griswold Controls or Flow Design, Inc., AutoFlow, or approved equivalent.

C. Unit Heaters & Fan Coils: Griswold Controls Threaded Mini, 2-32 psi range, 7.4 ft.

maximum head loss, 3/4 inch body.

D. AHU 18 & 19 Chilled Water Valves: Griswold Controls Threaded Flange, 2-32 psi range, 7.4 ft. maximum head loss, body size may exceed line size to meet the minimum head loss requirement.

E. AHU 18 & 19 Hot Water Valves: Griswold Controls Threaded Flange, 2-32 psi range, 7.4 ft maximum head loss, 1-1/2 inch body.

PART 3 - EXECUTION

3.1 INSTALL where shown on Drawings. Provide required clearances for access, maintenance, and safety.

3.2 TEST and obtain specified performance as required by Section 15042B - Tests.

3.3 ADJUST settings as necessary to obtain required performance.

3.4 PROVIDE all appurtenance items as required for installation per manufacturer's recommendations.

3.5 INSULATE in accordance with Sections 15060SB and 15250B.

END OF SECTION

SECTION 15090B - SUPPORTS, ANCHORS AND SEALS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 PIPING SYSTEMS: Supports and anchors for piping systems shall be in accordance with ANSI B31.1, "Power Piping" to maintain required pitch of lines, prevent vibration and provide for expansion and contraction movement.

1.3 REFERENCES:

A. ASME B31.1: "Power Piping"

B. MSS SP-58: "Pipe Hangers and Supports - Materials, Design and Manufacture"

C. MSS SP-69: "Pipe Hangers and Supports - Selection and Application"

D. MSS SP-89: "Pipe Hangers and Supports - Fabrication and Installation Practices"

1.4 SUBMITTALS:

A. Submit shop drawings in accordance with Section 15010B - Mechanical General Provisions.

B. Submittals shall be provided for hanger and support types according to pipe size, pipe service type, and exposure classification.

C. Submittals shall include manufacturer's product data, protection saddle product sheets, coating/finish product data sheets, and fabrication drawings necessary to confirm compliance with specified hanger types and details on the Drawings.

E. Submittals are required for all fabricated materials and assemblies to be furnished and delivered to the site.

F. Welded connections shall be indicated with standard AWS symbols (showing size, length, and type of each weld).

1.5 QUALITY ASSURANCE:

A. Materials and fabrication procedures shall be subject to inspection and tests in mill, shop, and at the site. Test shall be conducted by a qualified inspection agency employed by the Owner.

B. Such inspections and tests shall not relieve the Contractor of responsibility for providing materials and fabrication procedures in compliance with specified requirements.

C. Contractor shall promptly remove and replace materials or fabricated components which do not comply with requirements of Contract Documents.

D. Welded construction shall comply with AWS Code for procedures, appearance, and quality of welds and for methods used in correcting welding work.

1.6 QUALIFICATION FOR WELDING WORK:

A. Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

B. At Contractor's expense, provide certification to the Engineer that welders to be employed in the work have satisfactorily passed AWS qualification tests within the previous twelve (12) months prior to start of work.

C. If recertification of welders is required, retesting shall also be Contractor's responsibility.

1.7 DELIVERY, STORAGE, AND HANDLING:

A. Shipment and Delivery:

1. Identify equipment or shipping containers with following:

a. Item name
b. Item number, if any
c. Purchase Order number
d. Manufacturer and model number
e. Destination
f. Owner's name
g. Contractor's name

2. Ship items in appropriate labeled containers and crates.

3. Protect items from physical damage during shipment.

4. Receive, unload, uncrate and inspect all items specified and required for proper execution of this portion of work.

5. Upon receipt of items at project site, examine surfaces for defects and damage.

6. Return defective or damaged parts of supplier for repair or replacement so that schedule of this portion of work is not impaired.

7. Identify all documents certifying quality and compliance with Specifications and deliver to Owner's representative.

B. Storage:

1. Store items in dry, clean areas, safe from damage.

2. Maintain condition of all storage areas while items are stored.

3. Store pipe and associated accessories off floor or off ground.

4. Store small items and loose materials in clearly labeled, neatly arranged bins.

5. Protect ends of pipe, valves, and fittings from weather and abuse; keep open ends sealed or covered until removed for installation.

6. Store equipment and specialties in safe, clean, dry areas with open ends and pipe connection points covered until removed for installation.

C. Handling:

1. Unload, unpack, and handle items with extreme care; use slings, cradles, or other appropriate appurtenances.

2. Transport all items as required from unloading point to storage or installation location; protect components from damage during transportation.

3. Handle items in accordance with special instructions of manufacturer or supplier.

4. Replace parts damaged during transportation and handling at no additional cost to Owner so that schedule of this portion of work is not impaired.

5. Protect painted and machined surfaces where exposed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS: Support and hanger products are specified below by reference to Grinnell or Michigan figure numbers. Equivalent products by Bergen-Paterson, Grinnell, B-Line, Corner & Lada, Michigan Hanger Co., Gulf States, F&S Central, Crawford, Modern, or Pipe Shields, Inc. will be accepted.

2.2 SUPPORTS AND HANGERS:

A. General:

1. Contractor shall provide adequate pipe suspension systems in accordance with recognized engineering practices. All piping systems shall have adequate hangers, supports, guides and anchors designed in compliance with the latest requirements of the ANSI Code for Pressure Piping, B31.1.

2. Contractor shall perform accurate weight balance calculations to determine the required supporting force at each hanger location and anchor point and the pipe weight load at each equipment connection.

3. Hangers and supports shall be selected to support the weight of the pipe, fittings and valves, weight of the medium transported or the medium used for testing, whichever is heavier, and the weight of the insulation covering used.

4. All pipe and tubing shall be supported as required to prevent significant stresses in the pipe or tubing material, valves, and fittings and to support and secure the pipe in the intended position and alignment. All supports shall be designed to adequately secure the pipe against excessive dislocation due to thermal expansion and contraction, internal flow forces, and all probable external forces such as equipment, pipe, and personnel contact.

5. All materials used in manufacturing hangers and supports shall be capable of meeting the respective ASTM Standard Specifications with regard to tests and physical and chemical properties, and be in accordance with MSS SP-58 (Manufacturer's Standardization Society).

6. Hangers and supports shall be spaced in accordance with MSS SP-69 Table 3.

B. Hangers:

1. All hangers shall have some form of adjustment available after installation.

2. Type "A" hangers shall be standard weight carbon steel adjustable clevis type hanger with black or plain finish, approved by Factory Mutual and UL listed. Hanger shall be Grinnell Figure 260.

3. Type "B" hangers shall be standard weight carbon steel adjustable clevis type hanger with ASTM B633 SC1 or SC3 electro-plated zinc finish. Hanger shall be Grinnell Figure 260.

C. Hanger Rods:

1. Hanger rods shall be subjected to tension only. Lateral and axial movements shall be accommodated by proper linkage in the rod assembly.

2. Hanger rod diameters shall be based on MSS SP-69 Table 4.

3. Type "A" hanger system shall shall have ASTM A-36 carbon steel rods with plain or black finish.

4. Type "B" hanger systems shall have ASTM A-36 carbon steel rods with ASTM B633 electro-plated zinc finish.

D. Beam Clamps:

1. C-clamps with locknuts shall be used where applicable for hanger rod sizes 3/8" -

3/4" diameter. C-clamps shall be fitted with integral retaining clamps. Clamp assemblies shall be carbon steel or electro-plated zinc finish to comply with hanger system designation.

2. Welded beam attachments shall be used for rod sizes above 3/4" diameter and shall comply with hanger system materials as noted above.

2.3 PROTECTION SADDLES FOR INSULATION: Saddles for insulated pipes shall be prefabricated assemblies constructed of cellular glass insulation, two-piece 360 degree inserts with integral galvanized metal jacket, -450 to +1,200 deg. F service temperature, with insulation extending one inch beyond metal jacket. Thickness of insulation in the insert shall be equal to the insulation thickness scheduled for the service pipe where applied. Saddles shall be Model A2000 as manufactured by Pipe Shields, Inc. or approved equivalent.

2.4 FIRESTOP SEALS: All holes, voids, or openings created to extend mechanical systems through fire rated floors, partitions, and walls shall be sealed by the Contractor with an intumescent material capable of expanding up to 10 times when exposed to temperatures beginning at 250^{o}F. All firstrop systems shall be UL Classified and have ICBO, BOCAI, and SBCCI (NER 243) approved ratings per ASTM E-814 (UL 1479). Manufacturer shall be 3M, Dow Corning, Hilti, or approved equal. Refer to specific details on the Drawings.

2.5 MECHANICAL WALL SLEEVE SEAL (LINK-SEAL): Modular mechanical type wall sleeve seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall sleeve. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut. Tightening of the bolts shall cause the rubber links to expand and provide a positive, water-tight seal between the service pipe and wall sleeve. Wall sleeves shall be of Schedule 40 carbon steel with welded water-stop/anchor collar. Mechanical wall sleeve seals shall be "Link-Seal" model as manufactured by Thunderline Corporation or equal by MetraSeal.

2.6 MISCELLANEOUS SUPPORT MATERIALS:

A. Rolled Steel Plates, Shapes, and Bars: ASTM A36

B. Cold-Formed Steel Tubing: ASTM A500, Grade B; Fy = 46 ksi

C. Steel Pipe: ASTM A53, Type E, Non Tested, Grade B; Fy = 35 ksi

D. Anchor Bolts: ASTM A36

E. High-Strength Threaded Fasteners: Heavy hexagon bolts, nuts, and hardened washers complying with ASTM A325.

F. Electrodes for Welding: Comply with AWS Code, ASTM A233-E70 Series electrodes.

2.7 SHOP COATING SYSTEMS:

A. Shop Primer: Standard shop primer equal to Steel Structures Painting Council (SSPC) Specification No. 13. Total dry film thickness shall be not less than 2.5 mils. Verify compatibility of primer with specified finish paint. All miscellaneous steel supports provided for equipment, piping, and accessories furnished under Division 15B Specifications shall be fully coated with approved shop primer paint. Uncoated, bare steel supports will not be accepted.

B. Electro-Plated Galvanized: ASTM B633 SC1 or SC3 coating of zinc on steel by electrolysis from a bath of zinc salts. This coating is pure zinc and adheres to the steel with a molecular bond.

PART 3 - EXECUTION

3.1 SUPPORT SPACING: Space supports or hangers for horizontal standard weight carbon steel piping as follows. This spacing does not apply where there are concentrated loads between supports such as valves or specialties. Refer to appropriate tables in MSS SP-69 for recommended

support spacing for Copper Tube (Water Service or Air, Steam, or Gas Service).

A.

NOMINAL PIPE Sizes, Inches	MAXIMUM SPAN IN FEET Water Service	Air, Steam or Gas
1-1/2" and below	7	9
2" and 2-1/2"	10	13
3"	12	15
4" and 5"	14	17
6"	17	21
8" and 10"	19	24
12" and 14"	23	30
16" and 18"	27	35
20" and 24"	30	39

B. Provide pipe hanger or support within 18" of every change in direction for piping 1-1/2" and below and within 3' of every change in direction for piping 2" and above.

C. Provide additional support as required to maintain alignment, avoid excess stress and prevent sagging where there are concentrated loads such as valves or specialties.

D. Provide anchors, braces, rigid supports or guides as required to restrict excessive motion in piping.

E. Support horizontal plastic piping and control air tubing every 4' and at every change in direction. Follow pipe manufacturer's recommendations for support spacing based on material type, application, and service temperature.

3.2 HANGER RODS: Use hanger rods sized as follows:

A. Ferrous piping and copper tubing:

2" pipe and smaller	3/8" diameter
2-1/2" and through 3-1/2"	1/2" diameter
4" and 5" pipe	5/8" diameter
6" pipe	3/4" diameter
8" through 12" pipe	7/8" diameter
14" and 16"	1" diameter
18" through 24" pipe	1-1/4" diameter

3.3 SUPPORT AND ATTACHMENTS:

A. Material and finish for hangers and supports shall be the same as the hanger type required for each location in the project. Use Type "A" hangers for all indoor applications and Type "B" hangers in Mechanical Rooms and outdoors.

B. Where piping or ductwork cannot be suspended from overhead supports, use substantial cast iron or welded steel wall brackets or trapeze supports to support the hangers, pipe seats, or roll stands, as conditions demand and as approved by the Owner's Representative.

C. Construct fabricated supports and brackets of structural grade miscellaneous steel and fasteners. Black or plain steel components, which are not specified to have a special finish, shall be delivered to the job site with a prime coat of paint. Touch up primer after fabrication and after installation. All exposed miscellaneous support steel shall, as a minimum, be prime coated with paint to minimize the potential for rusting.

D. Provide all miscellaneous steel, bridging, brackets, anchors, frames, bracing, plates, bolts, nuts, washers, and the like, necessary to properly support piping or ductwork. All steel, hangers and attachments shall be mounted to the building structural steel frame, concrete or masonry walls, structural concrete floors or concrete structural members. No attachments of any kind shall be made to the roof deck metal. Refer to Section 15010B - Mechanical General Provisions for paragraph entitled "Foundations, Supports, Piers, Attachments". Material and finish for all components shall be same as the hanger type required for each location.

E. Provide bracing and supports for all vertical pipe risers, with riser clamps at each floor level.

F. Arrangement and fabrication of all supports is subject to Owner's representative's approval.

G. Solid or perforated strap hangers and wire hangers will not be permitted, except for temporary supporting during construction.

H. Hanging from unreinforced metal roof deck or from cellular roof deck will not be permitted.

3.4 WELDED ATTACHMENTS:

A. All welded type support components shall be in accordance with MSS SP-58.

B. All attachments welded to the pipe shall be in accordance with MSS SP-58. Attachments welded directly to the pipe shall be compatible with the chemical composition of the pipe material and the process of attachment shall conform to the requirements for fabrication of the pipe with regards to preheating, welding, and stress relieving.

C. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of AISC Specification for the Design, Fabrication, and Erection of Structural Steel Buildings.

D. All welds shall be performed by certified welders in compliance with the welder's qualifications as specified in Section 15060B - Pipe, Pipe Fittings and Valves.

E. Repaint all existing or new building steel where the paint is scraped or burned away during welding operations to match existing paint finishes.

3.5 EXPANSION AND CONTRACTION: Use anchors and expansion bends in the installation where shown on Drawings, and as required to accommodate expansion and contraction movements and prevent undue stressing of pipe. Expansion loops shall, unless shown otherwise on Drawings, have appropriate pipe guides on each side of the loop to maintain alignment.

3.6 SEALS:

A. Sleeve diameters shall be sufficient to accommodate insulated pipe and/or firestop seals. See Section 15060B - Pipe, Pipe Fittings and Valves for detailed requirements for sleeves.

B. Firestop seals shall be installed in strict accordance with the UL Fire Resistance Directory and the manufacturer's recommendations and data sheets for each type of opening or void. Surfaces shall be smooth and without gouges or other irregularities.

C. Clean all surfaces that will be in contact with the penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect the proper fitting and adhesion of the installed sealant materials.

D. Seal all holes or voids made by penetrations to ensure an effective fire and smoke barrier.

E. Protect materials installed to seal fire rated penetrations from damage where installed on surfaces subject to traffic.

F. Verify thorough penetration seals by inspection of installed materials. Provide for accessibility to penetration seals for inspection by applicable code authorities.

G. Provide all installation accessories required to install the fire stopping seals in strict accordance with UL and manufacturer's recommendations. Accessories shall include, but not be limited to, sheet metal sleeves and brackets, backer rods, mineral fiber packing, sleeves, fasteners, and fire rated caulking.

H. Fire stopping seals shall be suitable for the penetration being protected as defined by UL and the manufacturer's published literature or data sheets for UL System numbers.

3.7 PAINTING:

A. Immediately after surface preparations, apply shop paint in accordance with manufacturer's printed instructions, and at a rate to provide a uniform dry film thickness as specified.

B. Use painting methods that will result in full coverage of joints, corners, edges, finished welds, and all surfaces.

C. Painting materials and methods shall comply with Specification Section "Painting" in the Contract Documents.

END OF SECTION 15090B

SECTION 15201B - VIBRATION ISOLATION

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 SUBMITTALS:

A. Submit drawings indicating components, dimensions, weights and loadings, static deflections, hanger sizes, spring sizes, materials of construction, required clearances, and location and size of field connections. Clearly indicate where the isolators are to be installed on the project.

B. Submit the required number of (submittals) product data sheets. Clearly indicate product features, options, loading, rated capacities, and other data pertinent to fully describe the product. Refer to Section 15010B for additional requirements regarding submittals.

C. Submit manufacturer's installation instructions.

1.3 DELIVERY, STORAGE AND HANDLING: Comply with manufacturer's installation instructions for handling, storage and protection of products furnished under this Specification. Refer to Section 15010B - Mechanical General Provisions.

1.4 WARRANTY:

A. Provide a full parts warranty for one year from start-up or 18 months from shipment, whichever occurs first.

B. The guarantee shall be in effect from the day of final acceptance.

C. The manufacturer shall guarantee his equipment to perform in accordance with specified performance.

D. The guarantee shall include all parts and labor to repair or replace factory defects.

E. Assembly, erection or installation by other than manufacturer's forces shall not affect his guarantee if performed in accordance with his instructions.

F. If inspection or supervision of assembly, erection or installation by a representative of the manufacturer is required to validate his guarantee, it is understood that this requirement is included in the purchase price of the equipment and components furnished under this Specification.

1.5 QUALITY CONTROL:

A. Products furnished under this Specification shall be provided by the same manufacturer for each specific application.

B. Vibration isolators furnished shall be specifically approved by the manufacturer for use in the intended application.

1.6 SHOP DRAWINGS:

A. Shop Drawings shall include, but not be limited to the following:

1. Overall arrangement, dimensions and weight loading of equipment and isolator loading for each isolator.

2. Rated static deflection, spring diameters, free height, compressed spring height, solid spring height, limit stops, clearances, and the like.

3. Dimensional and weight data for concrete inertia bases, steel and rail bases, and details of isolator attachment.

4. Indication of use and to which equipment item the product will be installed.

5. Vibration isolators shall be submitted along with the corresponding equipment shop drawings to verify compliance with Specifications for proper application of the isolators. Lump submittals of vibration isolators may need to be held for review in conjunction with the equipment to which the isolator is intended to be applied.

B. Submittal shall be clearly tabulated by unit or fan or pump number indicating isolator type, model number, number required, and isolator loading.

1.7 SHIPPING TAGS: Each vibration isolator shall be tagged at the factory with its specific location on the job, including equipment designation which corresponds to the application. Where required, isolators shall be identified to correspond to the specific corner load point of the scheduled equipment.

1.8 SUBSTITUTIONS: Refer to Section 15010B for specific requirements concerning substitutions and product options. Substitutions shall require written approval from the Owner's representative and shall be submitted by the Contractor as soon after contract awards as possible and before any materials are ordered. Substitute products that are submitted as a shop drawing without prior written request for offering as a substitute product may, at the Engineer's discretion, be returned or rejected by the Engineer.

PART 2 - PRODUCTS

2.1 GENERAL:

A. This Specification pertains to the furnishing and installation of vibration isolation devices for rotating or reciprocating mechanical equipment and piping systems attached thereto.

B. This work shall include all material and labor required for installation of the resilient mounting and suspension systems, adjusting each mounting system, and measurement of isolator system performance. Specific mounting arrangement for each item of equipment shall be as described herein and as indicated by schedules and details on the Drawings.

C. All vibration isolation equipment, shall be furnished by one of the following manufacturers: Kinetics (Peabody Noise Control), Mason Industries, Vibration Mountings & Controls, Vibration Eliminator, or Amber Booth. A single manufacturer for all vibration isolation equipment will be required except as specifically approved in writing by the Engineer or by his specific approval of shop drawings.

2.2 VIBRATION ISOLATION SYSTEMS:

A. General:

1. The vibration isolation systems described herein and identified by type letter designations shall be applied to specific classifications of mechanical equipment as indicated on the Drawings.

2. The minimum static deflection of the isolators for each classification of mechanical equipment shall be as indicated in the Specifications or on the Drawings.

B. System Types:

1. Type C Isolation: (Restrained Spring Mount)

a. Equipment with operating weight different from the installed weight such as chillers, boilers, and the like, and equipment exposed to the wind such as cooling towers shall be mounted on spring mountings as described in Type B Isolation, but a housing shall be used that includes vertical limit stops to prevent spring extension when weight is removed.

b. The housing shall serve as blocking during erection and cooling tower mounts shall be located between the supporting steel and roof or as shown on the Drawings.

c. The installed and operating heights shall be the same.

d. A minimum clearance of 1/2" shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. Minimum static deflection shall be 2".

e. Limit stops shall be out of contact during normal operations.

f. Mountings used out of doors shall have hot dipped galvanized housings and cadmium plated springs.

g. Products:

(1) Mason Industries Type SLR

(2) VMC Type AWR

(3) Amber Booth Type CTC-2

(4) Kinetics Type FLS

2. Type D Isolation: (Spring Hanger)

a. Vibration hangers shall contain a steel spring and 0.3" deflection neoprene element in series.

b. The neoprene element shall be molded with a rod isolation bushing that passes through the hanger box.

c. Spring diameters and hanger box lower holes sizes shall be large enough to permit the hanger rod to swing through a 30° arc before contacting the hole and short circuiting the spring.

d. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

e. Submittals shall include a scale drawing of the hanger showing the 30° capability.

f. Products:

(1) Mason Industries Type 30N

(2) VMC Type RSH 30A

3. Type E Isolation: (Precompressed Spring Hanger)

a. Vibration hangers shall be as described in Type D Isolation, but they shall be precompressed to the rated deflection so as to keep the piping or equipment at a fixed elevation during installation.

b. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load.

c. Deflection shall be clearly indicated by means of a scale.

d. Submittals shall include a scale drawing of the hanger showing the 30° capability.

e. Hangers shall be type PC30N as manufactured by Mason Industries, Inc., or equal.

4. Type F Isolation: (Duct Isolation Hanger)

a. Vibration hangers shall contain a steel spring located in a neoprene cup manufactured with a grommet to prevent short circuiting of the hanger rod.

b. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion.

c. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30° arc before contacting the hole and short circuiting the spring.

d. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

e. Hangers shall be provided with an eye bolt on the spring end and provision to attach the housing to the flat iron duct straps.

f. Submittals shall include a scale drawing of the hanger showing the 30°

capability.

g. Hangers shall be type W30 as manufactured by Mason Industries, Inc., or equal.

5. Type K Isolation: (Neoprene Pump Connectors)

a. Flexible neoprene connectors shall be used on all equipment as indicated on the Drawings or on the Equipment Schedule. They shall be manufactured of multiple plys of nylon tire cord fabric and neoprene both molded and cured in hydraulic rubber presses. No steel wire or rings shall be used as pressure reinforcement. Straight connectors shall have two spheres. Connectors up to and including 1-1/2" diameter may have threaded ends. Connectors 2" and larger shall be manufactured with floating galvanized flanges recessed to lock the connector's raised face neoprene flanges. Hoses shall be installed on the equipment side of the shut-off valves.

b. Connectors shall be rated a minimum of 150 psi at 220^{o}F. Flanged equipment shall be directly connected to neoprene elbows in the size range 2-1/2" through 12" if the piping makes a 90^{o} turn at the equipment. All straight through connections shall be made with twin-spheres properly pre-extended as recommended by the manufacturer to prevent additional elongation under pressure.

c. Submittals shall include two test reports by independent consultants showing minimum reductions of 20 DB in vibration accelerations and 10 DB in sound pressure levels at typical blade passage frequencies.

d. Elbows shall be Mason-Flex type MFNEC, straight connectors Mason-Flex type MFTFU or MFTNC, and control cable assemblies type ACC, all as manufactured by Mason Industries, Inc., or equal.

6. Horizontal Pipe Isolation:

a. The first three pipe hangers in the main lines near the mechanical equipment shall be as described in Type E.

b. When indicated or called for on the Drawings, the horizontal runs in all other locations throughout the building shall be isolated by hangers as described in Type D.

c. When indicated or called for on the Drawings, floor supported piping shall rest on isolators as described in Type C.

d. Heat exchangers shall be considered part of the piping run.

e. All Type E hangers or the first three Type C mounts as noted above, shall have the same static deflection as specified for the mountings under the connected equipment. (Note: If piping is connected to equipment located in basements and hangs from ceiling under occupied spaces, the first three hangers shall have 0.75" deflection for pipe sizes up to and including 3", 1.5" deflection for pipe sizes up to and including 6", and 2.5" deflection thereafter.)

f. All other hangers and mounts shall have a minimum steel spring deflection of 0.75".

g. Hangers shall be located as close to the overhead supports as practical.

7. Duct Isolation:

a. Discharge runs for a distance of 50' (fifty feet) from the air-handling unit shall be isolated from the building structure by means of Type F hangers or Type C floor supports.

b. Spring deflections shall be a minimum of 0.75".

PART 3 - EXECUTION

3.1 The Contractor and the vibration isolation manufacturer or his regularly designated and factory authorized representative shall perform the following tasks in addition to the supply and installation of isolation equipment:

A. Obtain the approved manufacturer's name, model number, and other necessary identifying data for each item of equipment to be resiliently mounted. Coordinate all resilient mounting systems with the exact equipment to be furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between the vibration isolation device fabricator and the equipment manufacturer shall be required.

B. Obtain all necessary data in regard to piping systems which are specified to be resiliently supported so that proper isolators can be selected. Select piping system isolators for proper coordination with the physical arrangement of pipe lines and with the physical characteristics of the building.

C. Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that all vibration isolators are installed in strict accordance with normally accepted practices for critical environments.

D. Replace at no extra cost to the Owner any isolators which do not produce the required deflection, are improperly loaded above or below their correct operating height, or which in any way do not produce the required isolation.

E. Cooperate with all other Contractors engaged in this project so that the installation of vibration isolation devices will proceed in a manner that is in the best interest of the Owner.

F. Notify the Engineer of any project conditions which affect vibration isolation system installation or performance and which are found to be different from conditions indicated by the Drawings or described by the Specifications. Should vibration isolation system installation proceed without such notifications, any remedial work required to achieve proper isolator performance shall be accomplished by the Contractor at no additional cost to the Owner.

G. Inspect the installed equipment for possible "short-circuiting" of vibration isolation systems by piping supports, misalignment, electrical connections, temperature control connections, drain lines, building construction, etc., and notify the involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify the Engineer so that preventative or remedial action can take place on a timely basis. Any

remedial measures required shall be undertaken by the contractor responsible at no additional cost to the Owner.

END OF SECTION 15201B

SECTION 15250B - INSULATION

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 INTENT: The intent of this Specification is to provide a quality installation which may not be attainable through the use of a standard composite consisting of insulation, vapor retarder and jacket assembled by an insulation manufacturer. However, in some installations, composites will be acceptable provided they meet the requirements of the Specifications relating to referenced standards for individual components.

1.3 STANDARDS: Insulation products and installation shall, as a minimum, comply with the National Commercial & Industrial Insulation Standards published by the Midwest Insulation Contractors Association (MICA), Omaha, Nebraska, latest edition.

1.4 DEFINITIONS:

A. All-Service-Jacket (ASJ): A white kraft paper bonded to aluminum foil and reinforced with glass fibers. The composite jacket has an integral longitudinal lap with a pressure sensitive tape lap sealing system.

B. Concealed Spaces: All areas other than finished spaces which are generally not visible after completion of the project.

C. Finishing Cement: A mixture of various insulating fibers, fillers, and binders with water, with or without hydraulic cement, to form a smooth trowelable paste insulation for application over insulating cement or unfinished block insulation.

D. Finished Spaces: All areas except pipe and duct tunnels, shafts and chases, and spaces above furred or dropped ceilings.

E. Foamed Plastic: Plastic expanded by thermal or chemical means, containing closed cells throughout.

F. Glass Fiber: A composite material consisting of glass fibers with a resin binder.

G. Mineral Wool: A generic term which applies to all types of inorganic fibrous insulations.

H. Perm: The measure of vapor transmission in grains of water through one square foot of a membrane in an hour at one inch mercury pressure difference.

I. PVC (Polyvinyl Chloride): A polymerized vinyl compound using chloride.

J. Rock Wool: A generic term which applies to all types of inorganic fibrous insulations. Also includes mineral wool products.

K. Sealer: A liquid coating used to prevent excessive absorption of finish coats into porous surfaces.

L. Solvent Weld: A bonding method which uses a liquid solvent to dissolve one substance or material to form an adhesive base to permanently seal a joint; usually associated with PVC plastic materials.

M. Vapor Retarder (formerly Vapor Barrier): A membrane installed on the high vapor pressure side of an insulation material to prevent moisture penetration. A vapor retarder shall have a rating of 0.02 Perms or less.

N. Vapor Retarder Jacket: Any material or composite meeting the requirements of a vapor retarder and used for the finish of insulation material. It may be factory furnished or field applied.

1.5 ACCEPTABLE MANUFACTURERS shall be the following, referred to hereafter by abbreviation.

A. Insulation - Glass Fiber Blanket, Molded Pipe, and Board Type:

1. Certain-Teed Corporation, Insulation Group - (C/T)
2. Knauf Fiberglass - (KF)
3. Manville Product - (MP)
4. Owens/Corning - (O/C)

B. Insulation - Foamed Plastic Types:

1. Armstrong World Industries - (AWI) - Armstrong
2. Rubatex

C. Insulation - Calcium Silicate Types:

1. MP
2. O/C
3. Pabco Insulation Division
4. Calsilite Insulation Products

D. Insulation - Cellular Glass Types:

1. Pittsburg Corning - (PC)

E. Insulation - Polystyrene Type:

1. Dow Corning - (DC)
2. Accessible Products Company - (APC)

F. Vapor Barrier Jackets - Factory Applied:

1. C/T
2. KF
3. MP
4. O/C
5. PC

G. Metal Jackets - Aluminum and Stainless Steel:

1. Childers Products Co.
2. Pabco Insulation Division
3. RPR Products, Inc.

H. Mastics, Adhesives, Sealants, Coatings:

1. AWI
2. Foster Products
3. KF
4. C/T
5. MP
6. O/C
7. PC
8. Rubatex
9. Childers Products
10. VIMASCO
11. Mon-Eco

I. Tapes:

1. 3M Corporation
2. Hardcast, Inc.
3. Ideal Tape Co.
4. Morgan Adhesives Co.
5. Nashua Tape Products
6. Shurtape (Shurford Mills - Tape Division)
7. Compac Corporation

J. Insulated Fitting Covers and Jacketing - PVC Types:

1. C/T
2. KF
3. MP
4. Foster Products

K. Substitutions: Under provisions of Section 15010B - Mechanical General Provisions.

1.6 QUALITY ASSURANCE: The installing Contractor for the insulation systems specified in this section shall have been in continuous, uninterrupted stable business for a minimum of five (5) years in the installation of industrial and heavy commercial insulating systems. The installing Contractor shall, upon request, provide a list of at least five (5) successful installations performed by his/her company that are similar in size and scope of this project.

1.7 QUALITY CONTROL:

A. All insulation shall be installed in a workmanlike manner by skilled workmen regularly engaged in this type of work.

B. Insulation shall be applied on clean, dry surfaces and only after tests and approvals required by the Specifications have been completed.

C. Insulation jackets shall be drawn tight, fitted smoothly, and wrinkle-free.

D. Do not use short pieces of insulation where a full length section will fit. Do not use damaged or crushed insulation products.

E. Do not insulate manholes, handholes, cleanouts, inspection stamps, and nameplates. Bevel, flash, and seal around insulation of adjacent surfaces. On equipment operating at temperatures below dew point of the space, provide removable insulation covers for such items and clearly mark the surface of the insulation cover to identify the hidden appurtenance (nameplate, inspection stamp, and the like).

F. Insulation on all cold surfaces (below 65^{o}F) shall be applied with a continuous unbroken vapor seal. Hangers, supports, anchors and the like that are secured directly to cold surfaces shall be adequately insulated and vapor sealed to prevent condensation. Continue insulation with vapor retarder through penetrations of walls, floors, and the like.

1.8 FIRE HAZARD RATINGS FOR INSULATION, fasteners, mastics, adhesives, and jacketing materials shall not exceed flame spread of 25, fuel contribution of 50 and when used indoors, smoke development of 50 as determined by ASTM E-84, E-87, NFPA 255, and UL 723 tunnel test ratings. Flameproofing and fireproofing treatments are not acceptable.

1.9 ASBESTOS of any type shall not be allowed in any materials used under this Section.

1.10 INSULATION INSERTS for use at pipe hangers and supports shall be as specified in Section 15090B - Supports, Anchors and Seals. Provide inserts of approved heavy density insulating material at all support points on piping two inches (2") diameter or larger to prevent insulation from sagging. Select inserts suitable for the operating temperature range of the installed piping system.

1.11 SUBMITTALS are required on all insulation, as hereinafter specified, to include manufacturer's material data, thickness for each service, standards compliance and installation procedures. Each item shall be a standard catalog product of an established manufacturer and of equal quality, finish, performance, and durability to that specified. Submittals shall include project specification and the specific technical paragraph reference which specifies each item and other information necessary to establish contract compliance of each item to be furnished. Deviations from the specifications and performance data shall be clearly itemized on the Shop Drawing cover sheet with technical paragraph reference of all non-complying items or features. Partial or otherwise incomplete submittals will not be acceptable and will be returned without review. Refer to Section 15010B for additional requirements.

1.12 ALTERNATE INSULATION MATERIALS: Substitutions for alternate insulation products, materials or assemblies shall be submitted by the Contractor as outlined in Section 15010B - Mechanical

General Provisions. Substitutions of alternative materials to improve quality, construction schedule or costs will be reviewed by the Owner's representative, provided the required documentation as called for in Section 15010B is furnished. Submit cost change data associated with the alternate insulation materials proposal for consideration by the Owner.

1.13 WHEN UNABLE TO PROVIDE LABELING as required, submit certificates from the manufacturer stating that materials meet specified requirements.

1.14 DELIVERY, STORAGE AND HANDLING:

A. Comply with manufacturer's instructions for transporting and handling insulation products.

B. Protect products from physical damage. Leave factory shipping cartons in place until installation.

1.15 GUARANTEE: The installing Contractor shall guarantee the installation of insulating systems installed under this specification for a period of one year from acceptance of the system by the Owner against deterioration of insulating value, compaction or water leakage under normal operating conditions.

PART 2 - PRODUCTS

2.1 MOLDED GLASS FIBER INSULATION: Pipes and Circular Ducts: ASTM C-547 preformed glass fiber insulation. Insulation shall be Class 1 or 2, rigid, non-combustible, one-piece pipe insulation with 850^{o}F maximum service temperature, nominal "K" value of 0.23 at 75^{o}F mean temperature, jacket permeance of 0.02 perms for ASJ facing. When specified for applications requiring a vapor seal, furnish insulation with ASJ and self-sealing lap (SSL) joint on longitudinal seams.

Acceptable Products:

A. C/T CertaBlue Bond SSL or ASJ, as specified.

B. KF Pipe Insulation ASJ-SSL or ASJ, as specified.

C. MP Micro-Lok AP-T Plus or AP, as specified.

D. O/C Fiberglas Heavy Density Pipe Insulation ASJ/SSL-II or ASJ, as specified.

2.2 FOAMED PLASTIC INSULATION: Pipe, Ductwork, and Equipment: ASTM C-534 closed cell elastomeric thermal insulation. Insulation shall be Type I (tubular) or Type II (sheet), water vapor permeability of maximum 0.20 perm-in per ASTM E-96, "K" value of 0.28 at 75^{o}F mean temperature, service temperature range of -40 to +220^{o}F. Insulation to 3/4" thickness shall have a flame spread rating of 25, smoke developed 50 per ASTM E-84.

Acceptable Products:

A. Armstrong AP Armaflex Pipe Insulation/Armaflex II Sheet Insulation

B. Rubatex R-180-FS Pipe Insulation/R-1800-FS Sheet Insulation

2.3 FLEXIBLE GLASS FIBER INSULATION: Ductwork, Equipment and Pipe Accessories: ASTM C-553 glass fiber blanket insulation (industrial type). Insulation shall be Type I/Class B-4, resilient, flexible blanket insulation with minimum density of 1.50 lb/cu.ft., 250^{o}F insulation service temperature, "K" value 0.25 at 75^{o}F mean temperature (at labeled thickness), and permeance of 0.02 perms for the FSK (aluminum foil-fiberglass scrim-laminated kraft) facing.

Acceptable Products:

A. C/T Duct Wrap

B. KF Duct Wrap

C. MP Microlite Duct Wrap

D. O/C All Service Duct Wrap

2.4 RIGID GLASS FIBER BOARD INSULATION: Ductwork and Equipment: ASTM C-612 glass fiber board insulation (industrial type). Insulation shall be Class 1, rigid, heavy density board insulation with minimum density of 6.0 lb/cu. ft., 450^{o}F insulation service temperature, "K" value 0.22 at 75^{o}F mean temperature, and permeance of 0.02 perms for the FSK facing.

Acceptable Products:

A. C/T Industrial Insulation Board (IB 600)

B. KF Insulation Board (6.0)

C. MP 800 Series Spin-Glas (#817)

D. O/C 700 Series Insulation (#705)

2.5 CALCIUM SILICATE INSULATION: Pipe and Equipment: ASTM C-533 calcium silicate pipe and block insulation. Insulation shall be Type 1, rigid, heavy density half-section or block form with a minimum average density of 13.5 lb/cu.ft., minimum 150 psi compressive strength for five percent compression (based on 1.50" block thickness), 1200^{o}F insulation service temperature, and "K" value of maximum 0.40 at 200^{o}F mean temperature. The insulation shall not contribute to stress corrosion cracking of austenitic stainless steel, and shall meet the requirements of ASTM C-795. Insulation flame spread and smoke developed ratings shall be zero (0).

Acceptable Products:

A. MP Thermo 12/Blue Pipe and Block insulation

B. O/C Kaylo insulation

C. Pabco Super Caltemp insulation

D. Calsilite Calcium Silicate insulation

2.6 CELLULAR GLASS INSULATION: Pipe and Equipment: ASTM C-552 for cellular glass block and pre-formed pipe insulation. Product shall be rigid, 100 psi compressive strength, minimum 8.0 lb/cu.ft. average density, service temperature range of -450^{o}F to +900^{o}F, "K" value of 0.33 at 75^{o}F mean temperature. Insulation shall be non-combustible and have a water-vapor permeability of 0.00 perm-in. Material shall be pure glass, totally inorganic containing no binders, and have a UL flame spread rating of 5 and a smoke developed rating of 0. Insulation shall be PC Foamglas.

2.7 POLYSTYRENE INSULATION: Piping: Product shall be rigid, 20 psi compressive strength, minimum 1.6 lb/cu. ft. average density, service temperature range of -297 deg. F to +165 deg. F, "k" value of 0.24 at 75 deg. F mean temperature. Insulation shall have a water-vapor permeability of 1.5 perm-inch. Material shall be manufactured by expanding molten polystyrene in a continuous extrusion process to form a rigid, closed-cell foam with a uniform, void free, micro-cellular structure. Insulation shall have a flame spread rating of 5, for insulation thickness of 1" and less, the smoke developed rating shall be 115; for insulation thickness greater than 1", the smoke developed rating shall be 165. When specified for applications requiring a vapor seal, furnish insulation with ASJ and self-sealing lap (SSL) joint on longitudinal seams. ASJ facing shall have a maximum permeance of 0.02 perms.

Acceptable Products:

A. DC

B. APC

2.8 VAPOR RETARDER (VAPOR BARRIER) JACKETS:

A. PVC Pipe Covers and Accessories - Pipe:

1. PVC jackets and accessories shall be self-extinguishing type, flame spread 25, smoke developed 50 as tested per ASTM E-84. Products shall also comply with

NFPA 90A and 90B.

2. PVC jackets and accessories shall have a service temperature range of 0 to 500°F (ambient temperature range of 0 to 150°F) and moisture transmission less than 0.05 perms.

3. PVC jackets and accessories shall be minimum 20 mil (0.020 inch) thick, suitable for use with solvent type welding adhesive. All jacketing materials shall have a smooth, high gloss (sanitary) finish, UV resistant. Color: White.

4. Adhesives, tapes, sealant, and solvent weld compounds shall be compatible with the jacketing materials and recommended for use by the manufacturer. Vapor retarder jackets applied to the insulation shall also be compatible with the PVC jacketing.

5. Furnish precut or field fabricated insulation inserts for all pipe fittings and accessories. Insulation inserts shall be constructed of insulation matching the service pipe insulation.

6. For piping and round ductwork applications, provide pre-curled jacket sections sized to yield a minimum one inch (1") overlap of the installed insulation assembly. Pre-curled jacketing shall be MP Zeston 2000 PVC Cut & Curled jacketing or approved equal.

7. Acceptable products, subject to compliance with this specification: MP Zeston 2000 PVC, Foster Speedline 25/50 Smoke-Safe, Accessible Products Company Type 800HD, or approved equal.

B. Kraft and Foil - Pipes and Equipment: Meet or exceed ASTM C-1136, NFPA 90A requirements, permanently flame retardant and U.L. listed. Outer ply - minimum 35 lb. white bleached embossed kraft. Inner ply - aluminum foil reinforced with fiberglass yarn 1/16" o.c. both directions. Ply bonding adhesive - flame extinguishing. Water vapor permeance 0.02 perms or less, -20 to +450°F service temperature. Plain joint laps for field applied adhesive or laps with pressure sensitive adhesive will be accepted. Acceptable products: MP type AP or AP-T Plus, O/C 25 ASJ, C/T ASJ, or KF ASJ or equal.

C. Foil-Scrim-Kraft - Ductwork: Meet NFPA 90A requirements, permanently flame retardant and U.L. listed. Inner ply - minimum 40 lb. flame resistant paper. Outer ply - aluminum foil, ply bonding adhesive - flame extinguishing. Water vapor permeance 0.02 perms or less, 40 to 250°F service temperature. Acceptable products: MP type FSK, O/C FRK 25, C/T FSK, or KF FSK.

2.9 PROTECTIVE/FINISH JACKETS:

A. Canvas - Pipes, Ducts and Equipment: (Field Applied) U.L. listed, plain-weave 100 percent cotton fabric with hard twisted yarns, impregnated with a dilute fire retardant lagging adhesive, minimum 8.0 oz/sq.yd. unless scheduled otherwise. Furnish a certificate of compliance letter from the manufacturer to verify that the products provided meet the specification.

B. Fiberglass - Pipes, Ducts and Equipment: (Field Applied) Industrial quality fiberglass fabric constructed of glass fiber materials with a density of 0.094 lbs/cu.in. and tensile strength of 500 lbs. at 70°F. Jacketing fabric shall have a minimum density of 14 oz/sq.yd. and be treated by the manufacturer to contain a water-activated adhesive for lagging applications. Fiberglass jackets shall be Glas-Tex fabric (Style 84215, Finish 9995) as manufactured by J.P. Stevens Company, or equal.

C. Metal - Aluminum - Pipes and Accessories: (Field Applied)

1. Metal jacketing shall be 0.016" thick aluminum or aluminum alloys conforming to ASTM B-209. Metal jacketing installed outdoors shall be furnished with a stucco embossed pattern and 3/16" deep corrugated exterior surface. All jacketing shall have an integrally bonded moisture barrier coating over the entire surface in contact with the insulation. The moisture barrier coating shall be composed of one layer of one mil thick polyethylene film with a protective layer of 40 pound kraft paper, or the

equivalent, to prevent moisture and corrosives within the insulation from contacting the metal jacket and causing a galvanic or chemical corrosion.

2. Jacketing for straight pipe shall have a weathertight (or watertight) side crimp closure. Jacketing shall be equal to Aluminum Roll Jacketing by Childers Products Company.

3. Fastening devices shall be Type T-304 stainless steel bands, 0.020" thick, 3/4" wide, equal to Fabstraps by Childers Products Company.

4. Metal fitting covers shall be 0.024" thick aluminum with a smooth or stucco embossed exterior finish, moisture barrier coating on interior surface, and interlocking weathertight joints. Secure metal fitting covers with all-aluminum fasteners, such as pop-rivets, as necessary to secure fitting covers in place. Pop-rivets with galvanized or carbon steel pins shall not be used. Fitting covers for 90 or 45 degree elbows shall be equal to ELL-JACS Elbow Insulation Covers by Childers Products Company.

5. Miscellaneous insulation covers for Flanges, Valves, Blind Flanges, Reducing Flanges, Concentric/Eccentric Reducers, and the like, shall be constructed of 0.020" aluminum. Tees shall be constructed of two matching halves of 0.024" aluminum. All aluminum components shall have an integral moisture barrier coating, and all such fittings shall be either factory fabricated units or skillfully crafted field fabricated insulation covers.

6. Seal all laps, seams, joints and raw edges of aluminum jackets installed on outdoor piping or where required for indoor piping jackets with caulking or sealant; Childers Chil-Byl CP-76, Foster 95-44, or clear silicone caulking (G.E. 1200, or equal).

D. PVC Pipe Covers and Accessories - Pipe and Ductwork: (Refer to paragraph 2.8, Vapor Retarder Jackets.)

2.10 ADHESIVES (FIRE RESISTIVE):

A. Canvas Jackets: For securing field applied canvas jackets on insulation, with or without vapor retarder, lagging adhesive shall have a dry flame spread rating of 5 per ASTM E-162, 0 to 180^{o}F service temperature, water vapor permeance of 1.3 perms, white color, tough, washable finish when dry; Childers Chil-Seal CP-50A Coating, Foster Sealfas 30-36, Mon-Eco 11-02, or Vimasco 713.

B. Flexible Glass Fiber Insulation: For securing field applied flexible glass fiber insulation to ductwork, pipes & equipment (other than internal duct liner insulation materials), adhesive shall have a dry flame spread rating of 5 per ASTM E-162, -20 to 180^{o}F service temperature, fast drying synthetic elastomer adhesive designed to adhere fibrous glass insulation to sheet metal; Childers Chil-Stix Clear CP-85, Foster Stic-Safe 85-15, or Mon-Eco 22-05.

C. Foamed Plastic Insulation: For securing field applied foamed plastic insulation to ductwork, pipes and equipment, adhesive shall have a dried film flame spread rating not to exceed 25 per ASTM E-84 and smoke developed rating of 50, service temperature to 200^{o}F for pipe and sheet applications, contact adhesive for joining seams, butt joints, and surface adhesion; Armstrong 520 Adhesive, Rubatex R-373 Adhesive, or equal.

2.11 SEALANTS AND ACCESSORIES:

A. Sealants - Vapor Retarder Finish: For all interior field constructed vapor retarder finishes for equipment, fittings, valves, flanges, surface patches, joints, staple punctures, lap edges, flashings and the like: Dry flame spread rating less than 5 per ASTM E-162, 20 to 180^{o}F service temperature, water vapor permeance to 0.05 perms, white finish color, flexible, high build product suitable for use as a vapor retarder finish on pipe and block insulation and rigid thermal insulation. Vapor retarder finish coating shall be Childers Chil-Perm CP-30, Foster Tite-Fit 30-35, or Mon-Eco 55-10.

B. Sealants - Weather Barrier Finish: For all exterior field constructed weather barrier finishes for equipment, tanks, fittings, valves, flanges, surface patches, joints, lap edges, flashings and the like: Dry flame spread rating less than 5 per ASTM E-162, -20 to +200^{o}F service

temperature, water vapor permeance to 1.0 perm (aged value), white finish color, tough, durable, thixotropic trowelable product for use as mechanical protection and weatherproofing of outdoor thermal insulations. Weather barrier finish coating shall be Childers Vi-Cryl CP-10/11, Foster Sealfas GPM 35-00, Mon-Eco 55-50, or Vimasco WC-1.

C. Sealants - Foamed Plastic Insulations: For all exterior applications and indoor applications where specifically called for to provide a protective or vapor retarder coating on equipment, tanks, piping, fittings, valves, flanges, ductwork, joints, lap edges, flashings and the like: Dry flame spread rating less than 5 per ASTM E-162, white finish color, resistant to ultra-violet effects, compatible with insulation and adhesives, tough, durable, weather-resistant finish. Sealants for foamed plastic insulation shall be Armstrong WB Armaflex finish, Rubatex 374 Coating, Childers Vi-Cryl CP-10/11, or Foster Sealfas GPM 35-00.

D. Sealants - Cellular Glass Insulations: For all applications where a vapor barrier joint sealant is specified on equipment, tanks, piping, fittings, valves, flanges, ductwork, joints, lap edges and the like: Moisture and vapor barrier joint sealant and bedding compound for rigid insulation, service temperature of -20 to 200^{o}F, maximum 0.01 perm-inch water vapor transmission; Foster 30-46, PC Pittcote 300, or insulation manufacturer's recommended sealant.

E. Reinforcing Mesh for Sealants: For all sealants specified or recommended by the manufacturer to be applied with a reinforcing mesh: High strength, open-weave pre-sized and resin treated fiberglass cloth, minimum 6x6 mesh (6 strands by 6 strands per square inch) conforming to ASTM D-1688 Type III, non-combustible, flexible, not subject to rot, mildew, or decay; Childers Chil-Glas #5 (or #10) or equal. Vimasco Elastafab 894 constructed of modacrylic fibers, or equal, is also acceptable.

F. Cements for Pipe and Equipment: ASTM C-449 blended mineral fibers and inorganic refractory materials, hydraulic setting binder, thermal insulating and finishing cement for applications to 1200^{o}F. Product shall be trowelable over surfaces, valves, flanges, and irregular surfaces and be non-cracking and exhibit low-shrinkage. High temperature insulating cement shall be Pabco Pabcote One Coat Insulating Cement, Fibrex Superkote Cement, or equal by Power House.

G. Sealants - Miscellaneous Joints: ASTM C-920, Type S, NS, Class 25 construction sealant shall be non-toxic, weatherproof silicone sealant suitable for use in sealing construction joints, metal jacketing joints and seams, pipe hanger saddles, and the like. Sealant shall be General Electric Construction 1200 Series Silicon Sealant or approved equal. Color shall be translucent (clear) or white, as required to match adjacent material finishes.

H. Acoustical Sealants: Acoustical sealants for sealing around duct or piping penetrations of building construction materials shall be resilient, non-shrinking, non-hardening, non-drying, non-sag type sealant designed for interior use in sealing concealed construction joints. Apply acoustical sealant over a flexible, durable, non-absorptive, compressible rod stock (backer rod) of polyethylene foam, neoprene foam, or approved equal. Acoustical sealants shall be as manufactured by Tremco, U.S. Gypsum Co., Woodmont Products, or approved equal.

2.12 TAPE:

A. Ductwork Insulation: For sealing FSK vapor retarder jackets on ductwork insulation, use fiberglass scrim reinforced foil faced tape, nominal 3" width, permanently flame retardant and U.L. rated, permeance rating of 0.02 perms, mold and mildew resistant.

B. Piping Insulation: For sealing ASJ vapor retarder jackets on piping insulation, use matching tape with a foil inner layer with acrylic adhesive, fiberglass scrim reinforcement imbedded between an outer layer of bleached white fire retardant kraft paper and the inner foil layer. Tape shall be nominal 3" width for pipe insulation applications up to 7-1/2" OD and nominal 4" width for pipe insulation over 7-1/2" OD, permanently flame retardant and U.L. rated, permeance rating of 0.02 perms, mold and mildew resistant.

C. Insulating Tape: For insulating short lengths of piping and fittings in congested or hard to reach areas, use an elastomeric insulation tape equal to Armaflex Insulation Tape, Rubatex R-180-FS Insulation Tape, or Halstead Insulation Tape. Tape shall be nominal 2" wide, self-stick adhesive backing, 1/8" thick, and suitable for use on pipe surfaces to 160^{o}F. Use only

in applications specifically approved by the Engineer.

PART 3 - EXECUTION

3.1 INSPECT ALL SURFACES AND VERIFY that work of other trades requiring insulation has been completed and is ready to receive insulation. Specifically check for obvious defects such as leaking pipe or duct joints, broken fittings, hanger supports, and the like, that would result in damage to the completed insulation job, or that would adversely affect the execution and quality of the insulation systems as specified. Do not proceed with application of insulation until defects are corrected.

3.2 REMOVE ALL DIRT, SCALE, OIL, GREASE, or other extraneous loose material from surfaces to be insulated.

3.3 VERIFY that piping, ductwork, equipment, vessels and the like have been tested in accordance with the Specifications prior to applying insulation materials.

3.4 INSTALL SPECIFIED MATERIALS either as sequentially applied components or as a composite system if applicable. Follow manufacturer's installation guides and instructions.

3.5 PIPE AND EQUIPMENT INSULATION:

A. Molded Glass Fiber Insulation: Apply thickness shown in insulation schedule.

1. Sectional and segmental jacketed pipe insulation shall be applied so that ends of adjacent sections are butted tightly against each other. Sections of pipe furnished with all service jacket shall be securely taped in place on all longitudinal seams and circumferential joints. Sections of pipe furnished with all service jacket with self-sealing lap shall have the integral lap seam secured and all circumferential joints securely taped. Tape shall match the pipe insulation jacket.

2. Sectional and segmental unfaced pipe insulation shall be applied so that ends of adjacent sections are butted tightly against each other. Sections shall be securely wired or banded in place using not less than three ties of wire or two bands every eight inches (8") on center for each 3 ft. section on pipe sizes up to and including 6" size. For larger pipes, use two bands every eight inches (8") on center per 3 ft. section. Wires shall be drawn taut to embed them flush with the insulation, firmly twisted, excess clipped and ends bent over and fully embedded into the insulation prior to application of finish jacketing.

3. Flanges, Strainers, Automatic and Manual Valves and Bonnets: Cover with plain duct wrap of 1.5 lb/cu. ft. minimum density, wrapped firmly under compression, and wired in place. Finish with 1/4 inch layer of hydraulic insulating cement to a thickness equal to adjoining insulation.

4. Fastening: Secure insulation jacket with lagging adhesive (Childers CP-50A or Foster 30-36) if not provided with self-sealing pressure-sensitive adhesive. In areas not accessible after construction, also secure insulation with aluminum bands on 12 to 18 inch centers.

5. Cover fittings (standard or Victaulic type) with one piece PVC premolded fitting covers stapled or tacked in place. Apply over proper shape factory precut insulation blanket. Before applying fitting cover on piping requiring a vapor barrier, apply two vapor barrier mastic beads 1/8" in diameter around pipe covering close to end of covering before applying PVC cover. Wrap circumferential edges of cover with vapor-barrier pressure sensitive color matching tape. Overlap tape 2 inches on adjacent insulation and on cover.

B. Foamed Plastic Insulation: Apply thickness shown in insulation schedule.

1. Piping Applications:

a. Unslit tubular insulation shall be slipped onto piping before it is connected.

b. Preslit tubular insulation shall be rolled onto piping after fabrication.

c. Tightly butt adjacent sections and seal with a contact adhesive specifically approved by the insulation manufacturer (Armstrong 520, Rubatex R-373, or equal). Fabricate fitting covers from miter cut tubular insulation using over-sized insulation segments lapped over adjacent sections. Do not stretch insulation to fit; use proper lengths of materials.

d. Unless scheduled otherwise, indoor applications will not require protective finish coats. Provide high density insulation inserts (calcium silicate or compressed glass) at the hanger support and the pipe to prevent compressing the foamed plastic insulation at pipe hangers. Thoroughly seal all joints at the insulation inserts. When protective or weather barrier finishes are specified, apply a single layer of reinforcing fiberglass cloth fully adhered to the surface. Apply two finish coats of sealant specified for foamed plastic insulations. Adhesives and sealants shall be compatible and approved for use on foamed plastics.

C. Calcium Silicate Insulation: Apply thickness shown in insulation schedule.

1. Tightly butt edges, half-sections and break joints. Secure with wire for small areas, and aluminum bands 12" o.c. for large areas. Where required, provide welded studs, clips or angles as anchors for wires and bands.

2. Cover valves, bonnets, flanges, and fittings with molded calcium silicate fitting insulation where commercially available.

3. Cover valves, bonnets, flanges, and fittings with fabricated, mitered segments of molded calcium silicate of same thickness as insulation on adjacent pipe, wired in place. Finish with 1/4" thickness of hydraulic insulating and finishing cement.

4. Fittings on pipe sized 1-1/2" and smaller may be insulated with hydraulic insulating and finishing cement of same thickness as pipe insulation.

5. Cover equipment with fabricated, mitered segments of molded calcium silicate of same thickness as insulation on adjacent pipe, wired in place. Finish with 1/2" thickness of hydraulic insulating and finishing cement, with metal corner beads.

6. Cover equipment removable heads with 20 gage galvanized steel cover over insulation.

7. Where no additional finish is specified, apply 16 gage nickel copper alloy wire, 16 gage copper clad steel wire, or 16 gage stainless steel wire on 4" centers up to 6" pipe and 6" centers on pipe over 6" diameter.

8. Block insulation greater than 2" thick shall be applied in layers not exceeding 1-1/2" thick. All joints shall be staggered. Secure with wire. Cover with 1/2" thick hydraulic insulating and finishing cement. Protect all corners with metal corner beads.

D. Cellular Glass Insulation (Chilled Water Systems): Apply thickness and density shown in insulation schedule.

1. Apply single layer, half-sections of insulation to pipe and fittings. Provide fabricated coverings suitable for use on valves, pipe fittings, and hydronic specialties, fabricated in accordance with ASTM C552 for proper fit. Tightly butt edges and seal all joints full depth with Pittseal 444N Sealant as supplied by Pittsburgh Corning. Do not use sealant to fill voids or cracks. Check for tight seal at all joints and edges and reapply sealant as necessary. Do not use broken or cracked insulation products.

2. Secure insulation to piping with 0.5" x 0.020" aluminum bands with matching seals or, where approved by the insulation manufacturer, use one inch wide high tensile strength fiber reinforced strapping tape equal to Scotch Brand Filament Tape. Provide metal bands (or tape where approved) on maximum twelve inch (12") centers. Metal jacketing not required on indoor installations unless noted otherwise.

3. After securing in place, apply approved all service vapor barrier jacketing (ASJ) in accordance with manufacturer's recommendations. Provide a minimum two inch overlap of jacket at all joints, both circumferential and longitudinal. Jacket shall be thoroughly sealed to form a vapor barrier seal over the entire insulation assembly. Fittings shall be covered with approved PVC jacketing over the specified insulation.

4. Saddles shall be in accordance with the requirements of Section 15090B - Supports, Anchors and Seals.

5. On long, straight pipe runs, provide expansion joints at 20 foot intervals using wide joints of sealant equal to Childers Chil-Byl CP-76.

6. Verify that all sealants, mastics, and the like are compatible for use on the specified insulation systems. Allow adequate curing time for all sealants and mastics prior to covering with insulation finish systems.

7. Inspect all insulation and accessory materials to be certain that the installation is in conformance with the manufacturer's recommendations and the requirements of referenced ASTM standards and this Specification Section. All joints shall be tight with complete sealing for vapor barrier. Exterior finish shall be uniform, free of defects, and installed in a neat workmanlike manner.

E. Polystyrene Insulation (Chilled Water Systems): Apply thickness and density shown in insulation schedule.

1. Apply single layer, half-sections of insulation to pipe and fittings with ends of adjacent sections butted tightly against each other. Sections of pipe insulation furnished with all service jacket shall be securely taped in place on all longitudinal seams and circumferential joints. Sections of pipe furnished with all service jacket with self-sealing lap shall have the integral lap seam secured and all circumferential joints securely taped. Tape shall match the pipe insulation jacket.

2. Saddles for insulated chilled water pipes shall be in accordance with the requirements of Section 15090B - Supports, Anchors and Seals.

3. Cover fittings (standard or Victaulic type) with one piece PVC pre-molded fitting covers stapled or tacked in place. Apply over proper shape factory precut insulation blanket. Before applying fitting cover on piping requiring a vapor barrier, apply two vapor barrier mastic beads 1/8" in diameter around pipe covering close to end of covering before applying PVC cover. Wrap circumferential edges of cover with vapor-barrier pressure sensitive color matching tape. Overlap tape 2 inches on adjacent insulation and on cover.

3.6 DUCTWORK INSULATION:

A. Rigid Glass Fiber Board: Apply thickness shown in insulation schedule.

1. Cut insulation to fit between standing seams and stiffeners. Secure to metal with welded pins and self-locking caps installed flush with adjacent insulation surface. Pins shall be spotted 18" o.c. with not less than two rows of pins per side and with one pin spaced 3 inches in from each corner. Apply a heavy bead of vapor barrier sealant around each weld pin before installing cap. Caps shall match color of glass cloth jacket if used.

2. Cover fittings with material of same type and thickness. Score as necessary for curved surfaces.

3. Vapor retarders for FSK faced insulation shall overlap a minimum of 2" at all seams and be sealed with appropriate pressure sensitive tape or mastic. All penetrations, facing damage, and mechanical fasteners shall be covered with a minimum 2" overlap of tape or mastic.

4. Where scheduled, cover with finish jacketing of PVC or canvas.

B. Flexible Glass Fiber: Apply thickness shown in insulation schedule.

1. Sheet metal duct shall be clean, dry and tightly sealed at all joints and seams.

2. Wrap insulation around the duct with facing to the outside, butted to adjacent insulation. Seams shall be stapled approximately 6" on center with outward clinching staples and sealed with pressure sensitive tape matching the facing and designed for use with duct insulation. The underside of ductwork 24" or greater in width shall be secured with adhesive and mechanical fasteners and speed clips spaced approximately 18" o.c. The protruding ends of the fasteners shall be cut off flush after the speed clips are installed and then sealed with approved pressure-sensitive tape.

3. Adjacent sections of duct wrap insulation shall be butted tightly with a 2" tape flap of the insulation facing overlapping and secured with staples and pressure sensitive tape or two coats of vapor retarder mastic reinforced with one layer of 4" wide open weave glass fiber mesh.

3.7 CEMENTS, INSULATING AND FINISHING: Unless specified to the contrary elsewhere, provide a finished thickness of 1/2". Apply in two layers, reinforcing with No. 16 AWG 1" mesh galvanized wire netting. Trowel to a smooth hard finish. Install metal corner beads at all corners.

3.8 FIRE RETARDANT VAPOR RETARDER JACKETS FOR PIPE:

A. Apply adhesive and jacket over insulation. Seal lap with field applied adhesive or factory applied pressure sensitive lap adhesive.

B. Apply sealant to fittings, valves, flanges and similar items. Vapor seal these items by embedding reinforcing mesh (fiber glass fabric) between two 1/16" thick coats of adhesive. Lap seal fabric 1 to 2 inches on itself and 2 inches on adjoining insulation.

3.9 FIRE RETARDANT VAPOR RETARDER JACKETS FOR DUCTWORK AND EQUIPMENT:

A. Apply Foil-Scrim-Kraft with adhesive over glass fiber insulation unless Foil-Scrim-Kraft is furnished integrally with the flexible or rigid insulation. Apply fire resistive adhesive sealant to full surface of laps and secure them with staples applied 6" o.c. Vapor seal all lap edges, jacket breaks, penetrations and staples with matching foil reinforced Kraft tape 3" wide with integral or field applied full coverage coating of fire resistive adhesive. Lap tape not less than 1 inch on itself and adjacent insulation. Finish shall be wrinkle-free. Cover breaks and penetrations with 3 inch width strip of glass fabric embedded between two 1/16" coats of vapor retarder sealant, lapping fabric not less than one inch on adjacent insulation.

B. Apply flashing on pipe, ductwork and equipment for a complete moisture and vapor seal at all metal-to-insulation joints, exposed edges of insulation and other protrusions through jackets. Apply a continuous bead or fillet of flashing compound to completely seal the joint. Extend a 1/16" film of flashing compound over adjacent insulation and metal surfaces at least 3". Embed glass fabric into the wet coating over entire surface, smoothing out all wrinkles. Immediately apply a 1/8" film of flashing compound to the entire membrane surface leaving a large bead or fillet over the joint. All compound shall dry, then extend adjacent finish over the flashing a minimum of 3 inches.

3.10 CANVAS JACKET: Cover entire insulation surface with canvas embedded between two 1/8" thick layers of lagging adhesive. Overlap canvas at least 2" on itself and adjoining surfaces. Provide premolded PVC fitting covers for all insulated fittings, valves, and the like installed on systems scheduled to receive canvas jackets. PVC fitting covers shall be as specified elsewhere in this section.

3.11 FIBERGLASS JACKET: Cover entire insulation surface with fiberglass jacket between two 1/8" thick layers of lagging adhesive, liberally applied. Overlap fiberglass jacket at least 2" on itself and adjoining surfaces. When applied on chilled water pipe insulation systems, provide a continuous vapor seal and smooth exterior finish. PVC fitting covers shall be as specified elsewhere in this section.

3.12 METAL JACKET: Cover entire insulation surface of piping with aluminum jacket and fitting covers. Locate longitudinal joints along the side of horizontal piping, with the overlapped joint positioned to

shed water. Overlap circumferential joints 2" minimum. Seal all longitudinal joints and circumferential joints with vapor barrier sealant. Secure jacket in place with three (3) stainless steel bands per section of metal jacketing. Use all-aluminum pop-rivets on fitting covers where recommended by manufacturer.

3.13 INSULATION SCHEDULE (See Also Drawings):

A. General: Specific details and notes in this schedule shall take precedence over other paragraphs of this specification Section 15250B. For example, if the product specification in Part 2 above calls for 1.5 pounds per cubic foot minimum density, and this schedule calls for 3.0 pounds per cubic foot (PCF), then the scheduled 3.0 PCF applies to this job.

B. Piping: Piping insulation shall be as scheduled in Section 15060SB - Pipe, Piping Schedule - Materials and Insulation.

END OF SECTION 15250B

SECTION 15767B - FAN COIL UNITS

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 REFERENCES:

A. ARI 440 - Standard for Room Fan Coil Units

B. NFPA 90A - Installation of Air Conditioning and Ventilation Systems

C. SMACNA - HVAC Duct Construction Standards

D. ARI 350 - Standard for Acoustical Testing

1.3 QUALITY ASSURANCE:

A. The unit manufacturer shall be regularly engaged in production of components and shall have published complete catalog data on total product offering.

B. Units shall have certified capacity, static pressure, fan speed, brake horsepower and selection procedures in accordance with ARI Standard 440.

C. Unit Insulation shall comply with UL 181 and NFPA 90A

D. Units shall be UL or ETL listed.

1.4 EQUIPMENT SELECTION:

A. Unit selections are based on units scheduled. Where the Contractor provides units different from those scheduled, he shall be responsible for all changes to systems and other equipment incurred as a result of furnishing the different equipment.

B. Equipment layouts shown on the Drawings are based on units scheduled. The space available for this equipment is limited on this project. Where the Contractor elects to provide equipment other than that upon which the Drawings are based, he shall be responsible for fitting the equipment into the available space, providing adequate clearances for safety and good maintenance. Any changes required, such as routing of ductwork and piping, motor horsepowers, starters, electrical services, or architectural or structural changes, shall be the responsibility of the Contractor, at no additional cost to the Owner. No changes will be allowed without the prior approval of the Owner's representative.

1.5 SUBMITTALS:

A. Submit equipment shop drawings showing plans and sections of proposed arrangement and size of each unit, including maintenance access, filter removal spaces, and the like. Submit the following for approval:

1. Drawings indicating components, dimensions, weights and loadings, required clearances, location and size of all field connections, and assembly details.

2. Product data indicating rated capacities, weights, accessories, vibration isolation components, electrical requirements, and material finishes.

3. Complete sound performance data at design conditions (determined in accordance with ARI and AMCA Standards). Submit sound power ratings in decibel levels referred to 10^{-12} watts obtained in accordance with ARI 350 for each individual unit at the specified performance.

4. Motor data indicating voltage, phase, frame size, and RPM.

5. Unit performance data indicating selections in accordance with ARI Standard 440. Provide computer generated selection data to demonstrate compliance with the specified operating conditions.

6. All equipment and component warranties.

7. Manufacturer's installation instructions.

8. Operation and Maintenance manuals to include manufacturer's descriptive literature, start-up and operating instructions, maintenance procedures and parts lists.

B. The manufacturer shall guarantee all units, components and performance data to meet or exceed the specified performance requirements.

1.6 IDENTIFICATION:

A. Each unit shall be tagged at the factory with its specific location on the job, and the unit designation shown on the Drawing.

B. Provide permanently attached nameplate on each unit indicating manufacturer, model, capacity, voltage, and tag number.

1.7 WARRANTY: Contractor shall provide one year warranty from date of final acceptance.

1.8 DELIVERY, STORAGE, HANDLING AND PROTECTION:

A. Products shall be delivered to the site at the convenience of the Owner.

B. Products shall be stored and protected.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures. and finish. Units damaged by weather, construction activities, or mishandling shall be replaced at the Contractor's expense.

D. Any insulation that becomes wet due to exposure to weather shall be completely replaced. If units are double wall construction, the entire unit shall be replaced.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Units by Trane, McQuay or Carrier are acceptable provided the units meet the construction

and performance requirements specified herein and on the equipment schedule.

B. All units on the project shall be by the same manufacturer.

2.2 CONSTRUCTION:

A. Unit casing shall be 18 gauge minimum G60 galvanized steel.

B. All exterior panels shall be insulated with ½" minimum thickness closed cell or foil faced glass fiber insulation.

C. Drain pan shall be stainless steel or plastic construction. Drain pan shall be sloped in two planes and insulated with closed cell insulation. Drain connection shall be minimum 7/8" size.

D. Fan shall be direct drive centrifugal, double width double inlet, forward curve type with galvanized steel construction. Fan shall be statically and dynamically balanced.

E. Motors shall be three speed, permanent split capacitor type, permanently lubricated, with integral thermal overload protection and separate speed connection taps.

F. Coils shall be ARI 410 certified and labeled, pressure tested at 450 psig, 300 psi maximum working pressure, and leak tested at 100 psig. Fins shall be aluminum, mechanically bonded to 1/2" minimum OD tubes (3/8" tubes will be considered at the Owner's option). Coils shall be capable of continuous operation at 200^{o}F entering water temperature.

G. Filters shall be easily removable, 1" thick throw-away type with pleated media such as Farr 30/30 or equal.

H. Provide louvered bottom panels as scheduled. All exposed panels shall be constructed of 16 gauge minimum galvanized steel with 1 mil. minimum thickness electrostatic powder spray finish. All components requiring access shall be accessible from the bottom of the unit.

2.3 ELECTRICAL: Unit shall be provided with factory mounted electrical components as indicated on the Drawings and Schedules.

PART 3 - EXECUTION

3.1 FIELD SERVICES: Manufacturer shall provide on site system startup services as required for unit installation.

3.2 EXTRA STOCK: Provide filter sets for construction, startup, and testing.

END OF SECTION 15767B

SECTION 15840B - DUCTWORK

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 REFERENCES: (Latest edition for listed references shall apply.)

A. ASHRAE Handbook - Fundamentals (latest edition): Duct Design chapter.
B. ASHRAE Handbook - Equipment (latest edition): Duct Construction chapter.
C. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
D. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
E. ASTM A480 - Standard Specification for Stainless Steel Sheet, Plate and Strip.
F. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
G. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
H. ASTM B209 - Aluminum Alloy Sheet and Plate.
I. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
J. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
K. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
L. SMACNA - Duct Construction Standards.
M. SMACNA - Fire, Smoke and Radiation Damper Guide for HVAC Systems.
N. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 STANDARDS: Duct systems shall be in accordance with SMACNA Duct Construction Standards, the National Fire Protection Association, the North Carolina State Building Code, and manufacturer's recommendations where applicable.

1.4 SHOP DRAWINGS: Submit shop drawings of the following:

A. Ductwork layout and dimensions at minimum scale of 1/4" = 1'-0" for each floor level (to include project coordination details).

B. Ductwork layout, dimensions and sections at minimum scale of 1/2" = 1'-0" for each mechanical room and mechanical chase (to include project coordination details).

C. Rectangular duct reinforcements for 1", 2", 3", 4", and 6" w.g. class construction.

D. Intermediate duct reinforcement details.

E. Transverse joint reinforcement details.

F. Tie rod installation details.

G. Corner closure details.

H. Duct sealing details.

I. Fittings and other construction details to include: elbows, transitions, turning vanes, branch connections, offsets, obstructions, volume dampers, and air distribution connections.

J. Ductwork accessories to include: flexible connections, spin-in fittings, access doors, bird screen, gaskets, duct tape, duct sealant, sealer, and instrument test ports.

K. Flexible duct installation details.

L. Hangers and supports.

1.5 DUCTWORK MATERIALS:

A. HVAC Ductwork (General):

1. All HVAC ductwork, unless otherwise specifically indicated on the Drawings, shall be galvanized steel conforming to the requirements of ASTM A90, ASTM A525, and ASTM A527.

2. All low pressure insulated flexible ductwork shall meet the requirements of UL-181 Class 1 Air Duct, NFPA 90A and 90B, and the requirements of this Specification Section.

1.6 PRESSURE-VELOCITY CLASSIFICATION OF DUCTWORK:

A. Classifications shall be according to Table 1-1 in the SMACNA HVAC Duct Construction Standards - Metal and Flexible - latest edition, the accompanying information, the notes and schedules on the Drawings, and the following paragraphs.

B. HVAC Ductwork: Where pressure classification is NOT shown or scheduled on the drawings, the following shall apply:

1. One inch (1") water gage pressure class:

a. All ductwork associated with exhaust fans and downstream of VAVs.

2. Two inch (2") water gage pressure class:

a. All return duct.

3. Four inch (4") water gage pressure class:

a. All outside air intake ductwork.

b. All return duct between shafts and AHU.

4. Six inch (6") water gage pressure class:

a. All supply duct between AHU outlet to the fire dampers located at the outlets of the three-story fire rated shafts.

1.7 DUCTWORK SEALING REQUIREMENTS:

A. Sealing requirements shall be according to Table 1-2 in the SMACNA HVAC Duct Construction Standards, the accompanying information, and the following paragraphs. Oil based caulking and glazing compounds shall not be used.

B. HVAC Ductwork:

1. All ductwork of one inch (1") water gage class shall meet Seal Class C.

2. All ductwork of two inch (2") water gage class shall meet Seal Class B.

3. Three inch (3") water gage pressure class ductwork and higher shall meet Seal Class A.

1.8 OFFSETS, BENDS, AND RELATED WORK: The Drawings covering the work of other trades, and all work already existing, shall be thoroughly examined and arrangements made to provide all necessary offsets, bends, or changes, including duct enlargements and streamlined pipe and hanger rod casings, as required to resolve and eliminate conflict with other trades.

1.9 PRESSURE LOSS CALCULATIONS & EQUIPMENT SIZES:

A. The calculation of pressure losses and the sizing of fans and motors for each system has been based on the arrangement and sizes of ductwork, and the number and type of fittings and accessories shown on the Drawings.

B. Where additional fittings, accessories or size changes are required to install a duct system,

the pressure losses through the system shall be calculated by the Contractor and compared with the scheduled requirements.

C. The calculations, comparison and proposed revisions shall be submitted to the Owner's representative for approval.

D. If a change in fan and/or motor size is required, Contractor shall bear all costs. This includes the costs of duct changes, equipment changes, and re-arrangements, accessories, starters, conduit, wiring, controls and the like.

E. Shop drawings showing proposed changes shall be submitted for approval where changes are significant or impact the work of other trades.

PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS:

A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.

B. System "GS" (galvanized steel) shall meet requirements of ASTM A90, ASTM A525 and ASTM A527, "Steel Sheet, Zinc Coated by the Hot-Dip Process, Lock-Forming Quality", based on G-90 coating.

C. Insulated, low pressure flexible ductwork shall conform to the requirements of UL 181 and the requirements of this Specification Section.

D. Fasteners, such as rivets, bolts, or sheet metal screws, shall be of same material as duct system. Fasteners for galvanized steel shall be cadmium plated or galvanized steel.

2.2 SUPPORTS AND HANGERS:

A. Materials and Finish for supports, hangers, fasteners, and accessories shall be as scheduled for "hangers" in Section 15840S, and shall comply with the following:

1. System "BS" (black steel) shall be ASTM A-36 carbon steel with black or plain mill finish. Components shall be cleaned and painted with primer after fabrication. Primer shall be touched up after installation. Primer color shall be selected by Owner's representative.

2. System "GS" (galvanized steel) sheet materials shall meet requirements of ASTM A90, ASTM A525, and ASTM A527, "Steel Sheet, Zinc Coated by the Hot-Dip Process, Lock-Forming Quality", based on G-90 coating. Hanger rods, rolled-shapes, and other parts shall be ASTM A-36 carbon steel with ASTM B633 SC1 or SC3 electro-plated zinc finish.

B. Shop Coating Systems:

1. Shop Primer: Standard shop primer equal to Steel Structures Painting Council (SSPC) Specification No. 13. Total dry film thickness shall be not less than 2.5 mils. Verify compatibility of primer with specified finish paint. All miscellaneous steel supports provided for equipment, piping, and accessories furnished under Division 15 Specifications shall be fully coated with approved shop primer paint. Uncoated, bare steel supports will not be accepted.

2. Electro-Plated Galvanized: ASTM B633 SC1 or SC3 coating of zinc on steel by electrolysis from a bath of zinc salts. This coating is pure zinc and adheres to the steel with a molecular bond.

C. Fasteners such as rivets, bolts, or sheet metal screws, shall be cadmium plated or galvanized steel.

D. Hanger Rods shall be threaded continuously or threaded each end.

E. Hanger rods shall be subjected to tension only. Lateral and axial movements shall be accommodated by proper linkage in the rod assembly.

F. Support hangers by using beam clamps with lock nuts or retaining straps, or other special fastening devices, as required, for the support of hangers. Refer to specific details on the Drawings.

G. Beam Clamps:

1. C-clamps with locknuts shall be used where applicable for hanger rod sizes 3/8" - 3/4" diameter. C-clamps shall be fitted with integral retaining clamps. Clamp assemblies shall be plain carbon steel or electro-plated zinc finish.

2. Welded beam attachments shall be used for rod sizes above 3/4" diameter and shall comply with hanger system materials as noted above.

H. Where ductwork cannot be suspended from overhead supports, use substantial welded wall brackets or trapeze supports, as conditions demand and as approved by the Owner's representative.

I. Construct fabricated supports and brackets of structural grade miscellaneous steel and fasteners. Black or plain steel components, which are not specified to have a special finish, shall be delivered to the job site with a prime coat of paint. Touch up primer after fabrication and after installation.

J. Provide all miscellaneous steel, bridging, brackets, anchors, frames, bracing, plates, bolts, nuts, washers, and the like, necessary to properly support ductwork. All steel, hangers and attachments shall be mounted to the building structural steel frame, concrete or masonry walls, structural concrete floors or concrete structural members. No attachments of any kind shall be made to the roof deck metal. Refer to Section 15010B - Mechanical General Provisions for paragraph entitled "Foundations, Supports, Piers, Attachments". Material and finish for all components shall be same as the hanger type required for each location.

K. Arrangement and fabrication of all supports shall be subject to Owner's representative's approval.

L. Solid or perforated strap hangers and wire hangers will not be permitted, except for temporary supporting during construction.

M. Hanging from unreinforced metal roof deck or from cellular roof deck will not be permitted.

N. Welded and bolted attachments to the building structural steel shall be in accordance with the requirements of AISC Specification for the Design, Fabrication, and Erection of Structural Steel Buildings.

O. All welds shall be performed by certified welders.

P. Repaint all existing or new building steel where the paint is scraped or burned away during welding operations to match existing paint finishes.

Q. Painting:

1. Immediately after surface preparations, apply shop paint in accordance with manufacturer's printed instructions, and at a rate to provide a uniform dry film thickness as specified.

2. Use painting methods that will result in full coverage of joints, corners, edges, finished welds, and all surfaces.

3. Painting materials and methods shall comply with Specification Section "Painting" in the Contract Documents.

2.3 FITTINGS, DAMPERS AND ACCESSORIES FOR ALL DUCT SYSTEMS shall be of the same

material as the adjacent duct.

2.4 FITTINGS FOR FACTORY MANUFACTURED DUCT SYSTEMS shall be of same manufacture as the duct system with all dimensions and components compatible.

2.5 ROUND ELBOWS shall be smooth, stamped type or five-piece type having centerline radius of 1-1/2 times the duct diameter.

2.6 RECTANGULAR ELBOWS & AIR TURNING VANES (based on SMACNA 1990 Systems Duct Design, Table 14-10.G):

A. Elbows in supply, return, outside and relief air ductwork with a dimension larger than 12 inches shall be SMACNA smooth radius type with two splitter vanes and with a 0.30 minimum inside R/W.

B. Elbows in supply, return, outside and relief air ductwork with both dimensions being 12 inches or less may be constructed with no turning vanes, however, the minimum inside R/W shall not be less than 1.0.

C. Elbows in exhaust air ductwork shall be SMACNA smooth radius type with a 0.30 minimum inside R/W and with no turning vanes; except, where mitered elbows are absolutely necessary, they shall have turning vanes as described below.

D. Mitered elbows without turning vanes shall NOT be used. Where mitered elbows are absolutely necessary because of space limitation, single thickness SMACNA Type 1 turning vanes with minimum 3/4" long trailing edges shall be provided. Turning vanes shall be same material as ductwork, and shall have same sealing requirement as ductwork.

E. Vanes over 30" long in mitered elbows shall be single thickness as above, with intermediate supports or tie rods, or shall be double thickness airfoil SMACNA Type 1 or 4.

F. Trailing edges of single thickness vanes shall be properly aligned parallel with the duct.

G. The number, size, spacing, and construction details of vanes shall comply with the SMACNA HVAC Duct Construction Standards.

H. Provide splitter vanes of similar construction in duct transitions and other locations, where shown on Drawings.

2.7 DUCT TAPE shall be by the 3-M Company, Permacel Company, The Kendall Company or approved equal. Tape shall be minimum 12.0 mils thick and shall be plastic coated type for non-metallic ductwork and metal foil for metallic ductwork. Do not use a sealer with these type tapes. Tapes shall be as recommended by SMACNA.

2.8 DUCT SEALANTS shall be tested and labeled in accordance with UL-723 and conform to NFPA-90A Standards. Sealants shall not be water soluble and shall exhibit good adhesive strength qualities and lifetime aging characteristics. Flame spread and smoke developed ratings shall not exceed 25 when cured. Duct sealant shall be United Duct Sealer as manufactured by United McGill Corporation, or approved equal. If a tape or scrim is used in conjunction with the sealant, it shall be compatible with the sealant and shall be recommended by the sealant manufacturer. For ductwork exposed to weather, sealant shall be suitable for outdoor use.

2.9 TRANSVERSE DUCT JOINTS: Transverse joints shall be selected and applied consistent with the static pressure class, applicable sealing requirements, ductwork materials of construction, duct support intervals, and duct reinforcement requirements in accordance with SMACNA HVAC Duct Construction Standards. Notching, folding, bending and fit-up tolerances shall be appropriate for the composite duct assembly. Joints shall be sealed with approved materials in accordance with SMACNA Duct Sealing Requirements in Table 1-2 in the SMACNA HVAC Duct Construction Standards for the duct static pressure construction class. Bar or angle stock that is incorporated into the transverse joint shall be secured in accordance with SMACNA recommendations. Fasteners shall be appropriate for the ductwork materials of construction and shall be in accordance with SMACNA recommendations.

2.10 TRANSVERSE DUCT JOINTS (PROPRIETARY SYSTEM): (Contractor Option) For transverse

joints, 36" wide and larger, transverse duct joints shall be accomplished using components manufactured and supplied by Ductmate Industries, or prior approved equal, and shall comply with the following requirements:

A. All angle steel components shall comply with ASTM A-527 with G90 galvanized finish. All corner steel components shall comply with ASTM A-526 with G90 galvanized finish.

B. Joint sealant materials shall be Ductmate 5511M, or approved equal, and shall be as recommended by the joint system manufacturer. Joint sealant shall be non-skinning, non-oxidizing product capable of withstanding joint movement without cracking so as to provide an airtight and watertight flexible joint seal. Product shall have maximum flame spread rating of 10, smoke developed rating of 25.

C. Gasket materials shall be Ductmate 440 Tape, or approved equal, and shall be as recommended by the joint system manufacturer. Gasket materials shall be non-skinning, non-oxidizing product capable of withstanding joint movement without cracking or excessive deformation so as to provide a functional airtight and watertight flexible joint seal. Product shall have a maximum flame spread rating of 10, smoke developed rating of 25.

D. Duct joint systems shall have been tested in accordance with SMACNA test procedures with test results certified in writing by an independent testing laboratory. Tests of joint performance shall clearly indicate whether or not an external sealant was applied in conjunction with the manufactured duct joint system.

1. SMACNA Class "J" transverse joints shall be accomplished using the Ductmate '35' Systems as manufactured by Ductmate Industries. The Ductmate '35' Systems shall not be used with duct gauges heavier than 16 gauge or lighter than 26 gauge, in accordance with the manufacturer's recommendations.

2. SMACNA Class "F" transverse joints shall be accomplished using the Ductmate '25' Systems as manufactured by Ductmate Industries. The Ductmate '25' Systems shall not be used with duct gauges heavier than 20 gauge or lighter than 26 gauge, in accordance with the manufacturer's recommendations.

E. All components used to form the transverse duct joint system shall be of standard identifiable catalog manufacture as supplied by Ductmate Industries, or approved equal. All hardware items shall be labeled by the manufacturer so that they may be easily identified as to source of manufacture.

F. The construction of the ductwork, with regards to sheet metal gauge, reinforcing, seal class, and the like, shall be in strict compliance with the transverse duct system manufacturer's printed installation and applications literature, SMACNA duct construction standards, and the laboratory tested configurations of the duct joint system.

G. The transverse duct joint system shall conform to SMACNA guidelines and requirements for all transverse type joints. Finished joints shall maintain a deflection of less than 0.25" when the system is at standard operating pressure and shall maintain its structural integrity within the operating range of the system. The resulting mid-panel deflection of the joined ductwork sections shall not exceed 0.75" for ducts greater than 24" wide.

H. Transverse spiral and round duct joints may be accomplished with Spiralmate Round Duct Connector and accessory components as manufactured by Ductmate Industries or prior approved equal. Installation of Spiralmate Round Mate Connectors shall be in accordance with the manufacturer's printed instruction and installation manuals. The round connector shall consist of the following components: two mating round duct connector flanges with integral sealant; gasket between the two mating flanges; and a roll-formed closure ring that is drawn tight with a bolt and nut assembly.

I. The manufacturer of the components used to form the transverse duct joint shall guarantee all components against defective materials. The manufacturer shall also have factory trained representatives available to provide field assembly instructions to installing contractors.

J. Installation of all transverse duct joint systems shall be in strict compliance with the

manufacturer's printed instructions.

K. All non-complying components and joint systems installed without approved Shop Drawing submittals shall be removed by the Contractor without additional expense to the Owner and shall be promptly replaced with approved components and joining methods for a complete system.

2.11 TDC AND TDF JOINT SYSTEMS: Duct joint connection methods classified as TDC or TDF (all are non-proprietary joints) shall not be permitted without prior approval and confirming Shop Drawing submittals. The manufacturer or fabricator shall submit certified test reports from an independent testing laboratory to document the specific performance criteria and approved installation methods for all non-proprietary type joints proposed for installation under this Specification. In addition, submit product data sheets and installation details for duct joint components.

2.12 MANUAL VOLUME CONTROL DAMPERS:

A. Rectangular Dampers:

1. Manual rectangular dampers shall be constructed of minimum 16 gauge mill finish galvanized steel frames and blades with linkage out of the air stream. Dampers shall be opposed blade type and, unless noted otherwise, shall be furnished without blade edge seals. Blades shall be 6" wide, secured to nominal 1/2" diameter shafts. Bearings shall be molded synthetic type bearings or the equivalent. Furnish all manual dampers with a matching heavy duty hand quadrant with minimum 1-1/2" clearance for duct insulation systems. Manual dampers shall be Safe-Air Model 610, Ruskin Model CD35, or approved equal by National Controlled Air, Arrow, and Louvers & Dampers, Inc. for duct velocities up to 1800 fpm. Where duct velocity exceeds 1800 fpm, provide manual dampers equal to Ruskin Model CD50 or CD60.

2. Manual dampers for duct sizes up to 180 square inches or smaller may be single blade type construction of 22 gauge galvanized steel frame and blade. Damper shall be Ruskin Model MD25 or approved equal by National Controlled Air, Arrow, Louvers & Dampers, Inc., and Safe-Air. Furnish with integral locking hand quadrant with minimum 1-1/2" clearance for duct insulation systems.

B. Round Dampers: Manual round dampers shall be constructed of minimum 20 gauge mill finish galvanized steel frames and blades with linkage out of the air stream. Dampers shall be single blade type and, unless noted otherwise, shall be furnished without blade edge seals. Control shaft shall be nominal 3/8" square axle shaft that extends beyond the frame to a factory mounted (or field supplied) heavy duty locking hand quadrant with minimum 1-1/2" clearance for duct insulation systems. Manual dampers shall be Ruskin Model MDRS25, Safe-Air Model 613R, or approved equal by National Controlled Air, Arrow, and Louvers & Dampers, Inc.

C. Shop Fabricated Dampers (Rectangular or Round): In lieu of manufactured manual volume control dampers, the Contractor may construct shop fabricated damper assemblies in accordance with SMACNA HVAC Duct Construction Standards. Prior to fabrication, the Contractor shall submit shop drawings to the Engineer for approval. Shop Drawings shall indicate frame construction, blade construction, shaft type and size, shaft extension beyond duct wall, maximum and minimum sizes for each type of construction, material gauges, finishes, bearing assemblies, reinforcement, and the like. Furnish with integral locking hand quadrant with minimum 1-1/2" clearance for duct insulation systems.

2.13 INSTRUMENT PORTS shall be Duro Dyne Air Tight Instrument Test Port with neoprene expansion plug for instruments up to 1-1/32 and flat neoprene mounting gasket, or equal. Ports shall be air tight with heavy duty die cast construction, zinc plated heavy gauge cap and instant release wing nut.

2.14 ACCESS DOOR LATCH shall be Ventfabrics, Inc. No. 260 "Ventlock", or equal latch for doors large enough to enter only.

2.15 QUADRANTS, CONTROLS, INDICATING INSTRUMENTS and similar equipment shall be provided with extensions and/or brackets for mounting on the surface of the insulation of externally

insulated ducts.

2.16 SUPPORT AND BRACING MATERIAL for galvanized ductwork shall be galvanized steel. Dielectrically isolate galvanized steel supports from aluminum duct with two coats of zinc-chromate paint or bitumastic paint.

2.17 FLEXIBLE CONNECTIONS:

A. Large Flexible Connections (Greater than or equal to 8 feet total duct perimeter):

1. Connections shall be made with Duro Dyne Type "Super Metal Fab" wide span fabric or equal.

2. Indoor installation fabric shall be 6" wide Excelon type by Duro Dyne. Fabric shall be of tear resistant construction with a no-tear nylon base cloth. Weight of fabric shall be approximately 22 oz. per sq. yd.

3. Outdoor installation fabric shall be 6" wide Durolon type by Duro Dyne. Fabric shall be flame-proof, ozone resistant, heavy glass fabric having excellent weathering and abrasion qualities. Weight of fabric shall be approximately 24 oz. per sq. yd.

4. Integral metal connector pieces shall be nominal 3" wide, 24 gauge, metal "Grip-Loc" seam or equal.

5. Fabric and fabric assembly shall be UL listed and NFPA 90A approved.

B. Flexible Connections (Smaller than 8 feet total duct perimeter):

1. Connections shall be made with Duro Dyne Type "Metal Fab" fabric or equal.

2. Fabric shall be 3" wide Neoprene type by Duro Dyne. Fabric shall be of durable construction consisting of a heavy glass fabric double coated with Neoprene. Weight of fabric shall be approximately 30 oz. per sq. yd. Outdoor installations shall be Durolon type by Duro Dyne as specified above.

3. Integral metal connector pieces shall be nominal 3" wide, 24 gauge, metal "Grip-Loc" seam or equal.

4. Fabric and fabric assembly shall be UL listed and NFPA 90A approved.

2.18 SPLITTER, BUTTERFLY AND MULTI-BLADE DAMPERS shall be in accordance with SMACNA duct construction standards for the specified pressure-velocity classifications.

2.19 DUCT SLEEVES through floors shall be at least 14 gage galvanized steel.

2.20 FIRE DAMPERS shall be as follows:

A. Duct mounted dampers shall be dynamic factory built curtain type, with blades out of airstream (Type B).

B. Dampers shall have a minimum 1-1/2 hour fire protection rating and shall include a U.L. label in accordance with UL555 standard.

C. Dampers shall have a dynamic label that shall illustrate maximum allowed CFM at 8" static pressure for in-duct mounting and maximum allowed CFM at 4" static pressure for non-ducted, in-wall mounting.

D. Dampers shall have vertical and horizontal closure spring operation for assured closure under airflow.

E. Provide factory built sleeves of design and length to permit mounting within the opening, and as required to meet State Building Code requirements.

F. Factory manufactured fire dampers shall be by Ruskin, Prefco Products, Louvers and

Dampers, Inc., Safe-Air, National Controlled Air, or approved equal.

G. Fusible links shall be temperature rated in accordance with NFPA 90A.

H. Each fire damper type and rating shall be as required to maintain the fire resistive construction rating of the floor, wall or partition in which it is installed.

I. See Drawings for additional information and requirements.

2.21 FIRESTOP SEALS: All holes, voids, or openings created to extend mechanical systems through fire rated floors, partitions and walls shall be sealed by the Contractor with an intumescent material capable of expanding up to 10 times when exposed to temperatures beginning at 250^{o}F. It shall be UL Classified and have ICBO, BOCAI, and SBCCI (NER 243) approved ratings to 4 hours per ASTM E-814 (UL 1479). Manufacturers shall be 3M, Hilti, or equivalent by Dow Corning.

2.22 ACCESS DOORS:

A. Access doors shall have galvanized steel frames and galvanized steel door panels suitable for the applicable duct pressure class.

B. Doors shall have continuous zinc plated steel hinge.

C. Latches shall be galvanized steel sash type with galvanized steel strikes.

D. Doors shall be internally lined with 1" thick fiberglass inside a double panel construction.

E. Gaskets shall be PVC foam type or neoprene, and comply with the requirements of NFPA 90A for flame spread and smoke developed ratings.

F. If space does not permit door opening, removable door models may be used.

G. Access doors for round ductwork shall be of the rolled hinge plate design shaped to match the contour of the duct or bolted access door design with integral hand operated knobs to create a compression fit with the duct wall. Bolted type round duct access doors shall be Sandwich type by Ductmate Industries, or equal, and shall comply with the requirements of the general paragraphs above relating to access door construction.

H. Rectangular access doors for rectangular ductwork shall be Cesco Model HAD or CAD, or approved equal by National Controlled Air, Louvers & Dampers, Inc., Safe-Air, and Ruskin. Round access doors for rectangular ductwork shall be Flexmaster "Inspector Series" access doors, or approved equal by National Controlled Air, Louvers & Dampers, Inc., Safe-Air, and Ruskin.

2.23 INSULATED FLEXIBLE DUCTWORK:

A. Low pressure flexible duct shall be a factory fabricated assembly of a trilaminate of aluminum foil, fiberglass, and polyester with a perm rating of 0.02; high tear strength, and properties to resist temperature change, mildew, and age hardening.

B. The liner shall be mechanically locked, without adhesives, into a corrosive resistant galvanized steel helix formed on the ducts outside surface.

C. The duct shall be a U.L. listed 181 Class 1 duct material and shall comply with NFPA 90A and 90B.

D. The material shall have a positive pressure rating of not less than 6" w.c. through a temperature range of -20 to 250^{o}F.

E. The duct material shall be factory wrapped in a thick blanket of fiberglass insulation with a C factor of 0.23 or less.

F. The insulation shall be encased in a fire retardant reinforced aluminum material vapor retarder with a perm rating of not over 0.02.

G. The duct shall be rated for 4000 fpm duct velocity.

H. Provide adjustable diameter type self-locking nylon clamps as manufactured by Panduit, or equal.

I. Flexible duct shall be Type 5M as manufactured by Flexmaster or equal by Thermaflex.

J. Take-offs for flexible ductwork shall be made using conical bell-mouth type spin-in fittings with integral balancing damper, Flexmaster Model CB-D, or equal.

2.24 DAMPERS:

A. Control dampers for HVAC systems shall be provided to allow effective modulation or close-off of air flow as required for each fan system. Damper frames shall be constructed to facilitate field assembly of several individual sections into larger damper area and shall be provided with openings or mounting clips to allow secure fastening of damper frame to the surrounding ductwork, collar, or fan housing. Maximum blade length in any section shall be 48". Additional stiffening or bracing shall be provided with suitable bearings for smooth operation and all blades shall be interconnected to provide unison operation.

B. Dampers shall be provided with either parallel or opposed blade linkage and arranged for normally-open or normally-closed operation as shown on the Drawings. Multi-section dampers shall be provided with sufficient interconnecting hardware and jackshafts to provide unison operation of all blades in the entire assembly.

C. Low Leakage Control Dampers:

1. Frames shall be 5" x 1" x 0.125" 6063 T5 extruded aluminum channel. Dampers 12" high and less shall be equipped with low profile (5" x 1/2") frame dimensions.

2. Blades shall be 6" wide 6063 T5 heavy gage extruded aluminum airfoil shape.

3. Axles shall be 1/2" plated steel hex for positive connection with blades.

4. Bearings shall be non-corrosive two-piece molded synthetic.

5. Blade seals shall be extruded vinyl double edge design with inflatable pocket which enables air pressure from either direction to assist in blade to blade seal off. Blade seals shall be locked in extruded blade slots without the use of cement.

6. Jamb seals shall be aluminum flexible metal compression type.

7. Linkage shall be concealed in frame for low maintenance and reduced air turbulence.

8. Dampers shall be rated for temperatures from -50^{o}F to 250^{o}F.

9. Leakage rate shall be tested and rated in accordance with the Air Movement and Controls Association (AMCA) Standard 500 to have leakage ratings as listed below or better:

Damper Width	Maximum System Pressure	Maximum System Velocity	Leakage % of Max. Flow	Leakage CFM/ Sq.Ft.
48"	6.2 in. wg.	4000 fpm	0.067	2.7
36"	8.5 in. wg.	4000 fpm	0.075	3.0
24"	10.75 in. wg.	5000 fpm	0.060	3.0
12"	13.0 in. wg.	6000 fpm	0.050	3.0

10. Dampers shall be Model CD50 low leakage airfoil control dampers as manufactured by Ruskin, Arrow, or approved equal by National Controlled Air, Louvers & Dampers, Inc., Johnson Controls, and Safe-Air.

PART 3 - EXECUTION

3.1 DUCTWORK:

A. All ductwork shall be fabricated and installed in accordance with applicable SMACNA Standards according to the pressure class described in PART 1 - GENERAL.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

C. Ductwork shall be supported as recommended by SMACNA Standards from structural members. Ductwork shall not be allowed to rest on ceiling, light fixtures or structural members. Ductwork supported from joists shall be supported from the top chord of all joists.

D. Ducts, unless otherwise approved, shall be true to dimensions indicated, straight and smooth on inside with neatly finished joints; securely anchored to building in an approved manner, and installed to be completely free from vibration or chatter under all conditions of operation. Exact routing of ductwork will be dependent on location of structural members, and coordination with locations of other utilities. Route duct to avoid cutting structural members.

E. Brace ducts not more than 60 inches on center. Make slip joints in direction of flow, unless shown otherwise on the Drawings. Off-set ducts around obstructions where possible. The total included angle of duct tapers or transitions shall not exceed 45^{o} for diverging air flow or 60^{o} for converging air flow. However, in no case shall the angle between the air flow path entering the transition, and any side of the transition, exceed 30^{o} for diverging or converging air flow. In general, diverging transitions shall be limited to 15^{o} from the air flow path, and the above angles shall be considered maximum requirements.

F. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent of duct area, split into two ducts, maintaining original duct area.

G. Use double nut and lock washers on threaded rod supports.

H. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

I. All ductwork accessories shall be installed in strict accordance with manufacturer's recommendations.

3.2 SPECIAL ITEMS OF EQUIPMENT: Install special items of equipment in the duct systems, including automatic dampers, thermostats, humidistats, thermometers and other related controls, under the direct supervision of the Controls Contractor. Install fire alarm system smoke and temperature sensors under the direct supervision of the Electrical Contractor.

3.3 QUADRANTS, CONTROLS, INDICATING INSTRUMENTS: Mount quadrants, controls, indicating instruments and similar equipment on the surface of the insulation of insulated ductwork.

3.4 CROSS BREAK OR BEAD DUCTWORK having a width or depth in excess of 12 inches.

3.5 VOLUME CONTROL: Provide volume control and balancing dampers of the splitter, butterfly or multi-louver type for controlling air volume and direction and for balancing the system. Stiffen ducts at damper locations to provide adequate rigidity. Provide balancing damper for each supply diffuser or grille where branch duct connects to supply duct.

3.6 ACCESS DOORS: Provide access doors in duct for all automatic dampers, fire dampers, controls, filters, duct mounted smoke detectors, and similar equipment.

3.7 INSTRUMENT PORTS: Provide instrument ports in ductwork for pitot tube test where required for air flow measurement. Coordinate with TAB Contractor.

3.8 FLEXIBLE CONNECTIONS: Seal flexible connections and firmly band at each connection point. Flexible connections shall be not less than 4 inches in length.

3.9 FLEXIBLE DUCTS:

A. To connect flexible ducts to sheet metal ducts or equipment, apply duct sealer to inside of the flexible duct and secure the inner duct surface to the ductwork using a vinyl drawband.

B. Do not pressurize duct system for a minimum of 48 hours or as recommended by the manufacturer to allow sealant to dry.

C. After the connection has been made on insulated duct, reshape the insulation and vapor barrier over the duct end. Wrap twice around with duct tape, compatible with sealer, taking two or three tucks in the vapor barrier while taping.

D. Where flexible duct is used for elbows, construct so that length shall be sufficient to provide a radius not less than 1.5 times the diameter.

E. Support flexible ducts to prevent sagging more than 1/2" per foot of length between supports.

F. Support flexible duct within two (2) feet of connection to ductwork and terminal units. Maximum spacing between supports shall be six (6) feet.

G. Flexible duct lengths shall be at least 12 inches long and no more than 10 (ten) feet long, and shall be of the same nominal size as sheet metal duct or diffuser, grille or register neck, to which it connects.

H. Flexible ducts shall be used only at locations as shown on Drawings.

3.10 DUCT SEALING: Sealing shall be done as required in Part 1 - General in this section, using duct sealer, duct sealer and tape, or gaskets in accordance with SMACNA duct construction standards, manufacturer's recommendations, and this Specification.

3.11 FIRE DAMPERS:

A. Fire dampers shall be installed at all locations where ductwork penetrates any floor, wall or partition with a fire rating of 2 hours or more, and where otherwise shown or specified on the Drawings.

B. Fire dampers shall be installed at all locations where ductwork, with more than 100 square inches cross sectional area, penetrates walls or partitions with a 1-hour fire rating. Fire dampers are not required to be installed within ducts meeting all requirements listed below:

1. Duct cross sectional area shall be 100 square inches or less.

2. Duct shall be constructed of minimum 0.0217 inch thick steel.

3. Duct shall continue with no openings at least 5 feet on each side of rated wall.

4. Duct shall be installed above a ceiling.

C. Install fire dampers in accordance with manufacturer's UL approved printed instructions, or SMACNA's Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, whichever is more stringent.

D. Provide and locate access door to allow easy adjusting and link replacement.

E. Adjust fire dampers as follows:

1. Disconnect fusible link.

2. Operate the fire damper several times.

3. Adjust and correct each fire damper to assure free, positive operation and proper latching.

4. Reconnect fusible link.

3.12 FIRESTOP SEALS shall be installed in strict accordance with the manufacturer's recommendations for each type of opening or void. Surfaces shall be smooth and without gouges or other irregularities.

3.13 DUCT SMOKE DETECTORS shall be furnished by the Electrical Contractor under Division 16 and installed in the duct system by the Mechanical Contractor. All wiring and interlocks shall be furnished and installed by the Electrical Contractor.

3.14 CLEANING:

A. All ductwork shall be thoroughly cleaned inside and out prior to system startup, and shall be left in a neat and orderly manner. Duct sections, open ends, taps, and the like shall be covered with plastic at all times during construction to prevent entry of dust and debris.

B. See Section 15010B - Mechanical General Provisions, and Section 15042B - Tests, for additional requirements.

3.15 STARTUP, TESTING, ADJUSTING & BALANCING: See Sections 15010B - Mechanical General Provisions, and 15042B - Tests.

END OF SECTION 15840B

SECTION 15840SB - DUCTWORK SCHEDULE - SERVICE & MATERIAL SYSTEM

A. GENERAL NOTES & LEGENDS:

1. Refer to Section 15840B - Ductwork, and Section 15250B - Insulation, for detailed material and installation requirements. Refer to Section 15840B for insulated flexible ductwork. Note: Not all materials described in Part A of this Specification are used on this project. Refer to attached schedules for required material applications.

2. Ductwork & Hanger Material Legend: (See Section 15840B - Ductwork)

System	Description
AL	Aluminum
BS	Black Steel
GN	Galvaneal Steel ("PAINTGRIP")
GS	Galvanized Steel
SC	Black Steel with Steelcote S.S. Filled Urethane Finish
SS	Stainless Steel (316)
DI	Ductile Iron Pipe

3. Material Schedule - Ductwork Insulation: (See Section 15250B - Insulation)

System	Description
A	Molded glass fiber
B	Rigid glass fiber
C	Flexible glass fiber
D	Glass fiber duct liner - 1.5 lb/cu. ft.
E	Glass fiber duct liner - 3.0 lb/cu. ft.
F	Foamed plastic without finish
G	Foamed plastic with 2-coat finish

4. Jacket Material Legend: (See Section 15250B - Insulation)

System	Description
A	Foil-Scrim-Kraft
B	Canvas - field applied
C	Fiberglass - field applied
D	PVC sheet - field applied, solvent weld
E	Aluminum sheet - field applied
F	Stainless Steel - field applied

5. Insulation Thickness Legend:

050	=	1/2" Thick
075	=	3/4" Thick
100	=	1" Thick
150	=	1-1/2" Thick
200	=	2" Thick
250	=	2-1/2" Thick
300	=	3" Thick

6. Insulation Option Legend:

Insulation x / y in schedule means:
x - Contractor's Option #1 from Insulation Material Schedule
y - Contractor's Option #2 from Insulation Material Schedule

7. Jacket Option Legend:

Jacket x / y in schedule means:
x -Contractor's Option #1 from Jacket Material Schedule -use with Insulation Option #1.
y -Contractor's Option #2 from Jacket Material Schedule -use with Insulation Option #2.

B. SERVICE & MATERIAL SYSTEMS: See the following DUCTWORK SCHEDULE.

C. SCHEDULE NOTES:

1. See Drawings for more detailed requirements for ductwork pressure and seal classifications when not specifically scheduled.

2. Flexible ductwork shall not be used upstream of VAV terminal units.

Note: Area Definitions for "Ductwork Location" heading of attached Material Schedules shall be as follows:

MER = Mechanical Equipments Rooms

BUILDING DISTRIBUTION = Ductwork from opening of Three-Story Fire Rated Shafts to Inlet Side of VAV Box.

ROOM VAV DISTRIBUTION = Ductwork from VAV Box Outlet to Room Air Distribution Device.

SECTION 15840SB - DUCTWORK SCHEDULE - SERVICE & MATERIAL SYSTEMS

DUCTWORK SYSTEM: DUCTWORK LOCATION:		AHU-18, 19 Within Fire Rated Shafts	AHU-18,19 Room VAV Distribution	AHU-18,19	Exhaust Fans ALL	
Supply Air	Temperature Range	50°F-100°F	50°F-100°F	(See Spec.	-	
	Ductwork Material	GS	GS	Section	-	
	Hanger Materials	GS	GS	15841B)	-	
	Insulation	200C	150C		-	
	Jacket	A	A		-	
	Pressure Class (in.)	4.0	1.0		-	
	Seal Class	A	B		-	
	Notes	1	1		-	
Return Air	Temperature Range	-	-	55°F-85°F	-	
	Ductwork Material	-	-	GS	-	
	Hanger Materials	-	-	GS	-	
	Insulation	-	-	-	-	
	Jacket	-	-	-	-	
	Pressure Class (in.)	-	-	2.0	-	
	Seal Class	-	-	B	-	
	Notes	-	-	1	-	
Outside Air	Temperature Range	-	-	10°F-95°F	-	
	Ductwork Material	-	-	GS	-	
	Hanger Materials	-	-	GS	-	
	Insulation	-	-	100B	-	
	Jacket	-	-	A	-	
	Pressure Class (in.)	-	-	4.0	-	
	Seal Class	-	-	A	-	
	Notes	-	-	1	-	
Relief Air	Temperature Range	-	-	-	55°F-85°F	
	Ductwork Material	-	-	-	GS	* Insulation not required in shaft or on branch ducts.
	Hanger Materials	-	-	-	GS	
	Insulation	-	-	-	150C *	
	Jacket	-	-	-	A *	
	Pressure Class (in.)	-	-	-	2.0	
	Seal Class	-	-	-	B	
	Notes	-	-	-	1	

END OF SECTION 15840SB

SECTION 15870B - AIR OUTLETS & INLETS - DISTRIBUTION

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 DEFINITIONS:

A. Diffusers are ceiling mounted air supply outlets with built-in volume and flow direction adjustments. Diffusers are intended to rapidly mix supply air with room air.

B. Linear diffusers have one or more long slot-type air supply outlets with built-in volume and flow direction adjustments. Linear diffusers may be ceiling, wall or floor mounted.

C. Supply grilles and registers are ceiling, wall or floor mounted air supply outlets with adjustable vertical and/or horizontal air direction vanes. Vertical vanes shall be on the room side of wall mounted units.

D. Return grilles and registers are ceiling, wall or floor mounted air return or transfer inlets with fixed vertical and/or horizontal vanes. Vertical vanes shall be on the room side of wall mounted units.

E. Registers have built-in volume adjusting opposed-blade dampers, whereas grilles do not.

F. High capacity industrial grilles are wall or ceiling mounted air supply outlets offering directional control of large air volumes.

1.3 CEILING DIFFUSERS, GRILLES AND REGISTERS shall be as scheduled on Drawings.

1.4 ADJUSTABLE AIR EXTRACTORS shall be provided behind supply grilles and at branch ducts where shown on the Drawings and scheduled on the air distribution schedules.

1.5 SOUND PRESSURE LEVEL of all diffusers, grilles and registers shall not exceed NC 35 (Noise Criteria 35) in all areas (unless specifically noted otherwise), at the scheduled maximum air flow. NC ratings are based on sound power level re 10^{-12} watts minus an 8 db room attenuation in all octave bands.

1.6 SHIPPING TAG: Each unit shall be tagged at the factory with its specific location on the job, including building floor, room/area served, and the unit designation shown on the Drawings.

1.7 SUBMITTALS: Submit the following for each air distribution device:

A. Manufacturers details indicating components, dimensions, connections, clearances.
B. Performance criteria indicating type, size, cfm, NC rating, neck size, and throw pattern on each individual device.
C. Materials of construction.
D. Finishes.
E. Accessories and options.
F. Installation details and mounting methods.
G. Reference to the Contract Documents for performance information is unacceptable.

1.8 SAMPLES: Submit one sample of each air distribution device for review and approval.

PART 2 - PRODUCTS

2.1 DIFFUSERS, GRILLES, REGISTERS AND ACCESSORIES shall be the products of Metal Industries (Metal*Aire), Carnes, Titus Corporation, Price, Krueger Manufacturing Co., or Tuttle & Bailey.

2.2 ONE MANUFACTURER'S products shall be used for like components throughout the work. Do not mix manufacturers without the prior written approval of the Owner's representative or unless required to comply with product specifications and performance criteria.

2.3 PRODUCT MODEL NUMBERS, types, sizes, styles, accessories and other details shall be as scheduled on the Drawings.

PART 3 - EXECUTION

3.1 COORDINATE with General Contractor for all openings and penetrations required in building construction for air outlets and inlets, prior to the construction of work to be penetrated.

3.2 SURFACE MOUNTED OUTLETS AND INLETS: Fit surface mounted outlets and inlets tight against the surface on which they are mounted with no perceivable gaps between the outlet or inlet and the mounting surface and gasket of the grille, register, or diffuser.

3.3 INSTALL OUTLETS AND INLETS level and plumb with building surfaces. Fasten securely to the adjacent structure or surface as recommended by the manufacturer with matching tamper-proof fasteners.

3.4 PROVIDE T-bar panels as required to match standard lay-in ceiling modules.

3.5 INSTALL minimum 1-1/2" thick fiberglass blanket insulation with vapor retarder jacket securely taped to the backside (plenum side) of all supply diffusers installed in lay-in ceiling assemblies to prohibit the formation of condensate on the diffuser face.

END OF SECTION 15870B

SECTION 15900B - FMS CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.1 CONTRACT DOCUMENTS: The Contract Documents apply to this section.

1.2 SCOPE OF WORK - OVERVIEW:

A. Johnson Controls system shall be provided as the Base Bid on all controls for this project. Invensys (formerly Siebe) shall be provided as an Alternate Bid.

B. Two (2) new fan coil units and three (3) relocated existing terminal units. New controls to be provided for each unit and terminal unit and be connected to either the existing Johnson Controls system or the Invensys system (Alternate Bid).

C. It is intended that the Facility Management System (FMS) Control and Instrumentation work shall be a subcontract to the Mechanical Contractor. Where the Specification refers to the FMS Controls Contractor, it shall be understood that the FMS Controls Contractor is a subcontractor to the Mechanical Contractor.

D. Furnish and install a complete electronic Building Automation System for the HVAC system, including all control accessories, hardware, software, and devices necessary to execute the sequence of operation.

E. These Specifications, together with the information shown on the Drawings, define the automatic control of all equipment described under "Sequence of Operation". The automatic temperature control system includes, but is not limited to, temperature transmitters, controllers, automatic dampers and valves, damper operators, switches, control panels and other accessory equipment and devices along with a complete system of control and electrical wiring to fulfill the intent of these Specifications and to provide for a complete and operable system.

F. The system shall be installed, started-up, and serviced by factory trained mechanics and system specialists regularly employed by the manufacturer of the control equipment.

G. The system vendor shall have an operating branch office within 100 miles of the job site, and shall show proof of this branch office providing engineering, installation, start-up, on-going support and services for the proposed type system for the past 10 years.

H. Contractors shall note that the requirements of this section are specific and describe in detail the exact components and system capabilities necessary for the optimum operation of the facility's HVAC equipment. All requirements will be strictly interpreted and enforced by the Engineer and his representative. Failure to comply with any provision may result in rejection of submittals and/or default.

I. The Mechanical Contractor shall include in his bid all work required by the Mechanical Contractor in this section, such as the installation of control valves and dampers, sensors and the like.

J. The above overview is general and is not all-inclusive. Refer to the Specifications and Drawings for the complete work required.

1.4 GENERAL:

A. Include all labor, materials and appliances required for furnishing, installing testing, adjusting and placing in operation all control and instrumentation work shown on the Drawings and specified herein, complete and satisfactory to the Owner's representative.

B. The FMS Controls Contractor shall furnish and install all equipment, accessories, electrical work and instrument piping required for complete and functioning control system except as described under "Work by Others" in Part 3 of this Section.

C. All materials and equipment used shall be standard components, regularly manufactured

for this and/or other systems, and not custom designed especially for this project. All systems and components shall have been thoroughly tested and proven in actual use. No used or existing control equipment will be permitted in the new control system.

D. The DDC (Direct Digital Control) System shall be of a fully modular architecture, permitting expansion by adding computer memory, application software, operator peripherals and field hardware.

E. Tie-ins are required into Mechanical Contractor furnished equipment. The FMS Controls Contractor shall coordinate.

F. The FMS Controls Contractor shall provide a permanently assigned engineering and construction coordinator that is experienced in coordination and directing work of the magnitude and complexity of this project. The FMS Controls Contractor shall submit for review and acceptance by the Engineer prior to commencing the work, the name of the proposed coordinator to be assigned to this project. This coordinator shall be assigned to this project until final site visitation unless otherwise released by the Engineer.

G. Asbestos shall not be present in any materials or equipment provided on this project.

1.5 WORK BY OTHERS:

A. Automatic control valves and separable wells for immersion elements shall be furnished by the Controls Contractor and shall be installed by the Mechanical Contractor under this contractor's supervision. The Mechanical Contractor shall provide and install pressure taps, isolation valves and other couplings required by any pressure and/or flow instrumentation specified below.

B. Automatic (control and smoke) dampers shall be furnished and installed by the Mechanical Contractor, or his Sheet Metal Subcontractor, under this Contractor's supervision. It shall be the responsibility of the Mechanical Contractor or his Sheet Metal Contractor to see that the dampers are correctly installed so that they operate freely and close tightly. It shall be the responsibility of the Mechanical Contractor or his Sheet Metal Contractor to provide and install transitions when the control application requires dampers smaller than duct size. It shall be the responsibility of the Mechanical Contractor or his Sheet Metal Contractor to provide and install oval to rectangular transitions when the control application requires dampers in oval or round duct.

C. Smoke detectors shall be furnished by the Electrical Contractor, installed by the Mechanical Contractor, and wired by the Electrical Contractor.

D. VAV Terminal Units: The FMS Controls Contractor shall furnish and install the space sensor. The FMS Controls Contractor shall connect all control devices to the individual VAV controllers.

E. All finish painting required for building management and control equipment shall be done by the Controls Contractor.

F. All cutting and patching necessary for the installation of the Building Management and Control System shall be done by the Controls Contractor. See Section 15010B for detailed requirements for cutting and patching.

G. Refer to Section 15010B for complete details of Mechanical, Electrical, and Controls work coordination.

1.6 REFERENCED STANDARDS, CODES, AND ORDINANCES:

A. It is the responsibility of the Controls Contractor to be familiar with all codes, rules, ordinances, and regulations of the authority having jurisdiction and their interpretations which are in effect at the site of the work.

B. The latest issue of applicable standards and recommended practices of the following agencies in effect shall form a part of the specification to the extent each agency's relative standards or recommended practices apply to the systems and their components as

specified herein.

1. Federal Communications Commission (FCC)
2. American National Standards Institute (ANSI)
3. American Society of Mechanical Engineers (ASME)
4. Electronic Industries Association (EIA)
5. Institute of Electrical and Electronics Engineers (IEEE)
6. National Electrical Manufacturers Association (NEMA)
7. National Fire Protection Association (NFPA)
8. Underwriters Laboratories (UL)
9. Occupational Safety and Health Administration (OSHA)
10. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)

C. The Controls Contractor shall be solely responsible for compliance with all health and safety regulations, performing the work in a safe and competent manner, and shall use industry accepted installation procedures required for the work as outlined in these documents.

D. All systems' equipment, components, accessories, and installation hardware shall be new and free from defects and shall be UL listed where applicable. All components shall be in current production and shall be a standard product of the system or device manufacturer. Refurbished or reconditioned components are unacceptable. Each component shall bear the make, model number, device tag number (if any), and the UL label as applicable. All systems' components of a given type shall be the product of the same manufacturer.

1.7 INTENT OF SPECIFICATIONS AND DRAWINGS:

A. It shall be understood that the Drawings and Specifications describe the approximate locations of the work. Do not scale the Drawings to determine exact positions and clearances. Obtain from the Engineer any dimensions not shown.

B. Bring to the attention of the Engineer, immediately, any changes in the size or location of the material or equipment which may be necessary in order to meet field conditions, or in order to avoid conflict with the equipment of other sections. Obtain the Engineer's approval before such deviations are made.

C. Details of construction and of workmanship, where not specifically described herein or indicated on the Drawings, shall be subject to the Engineer's approval.

D. Obtain from the Engineer at the site the location of any apparatus not definitely located on the Drawings. Locate equipment and accessories in such a manner as to provide easy access for proper service and maintenance. Special care is required to provide accessibility to openings in equipment requiring maintenance. Bring to the attention of the Engineer any condition which prevents adequate accessibility for maintenance, prior to installation of that work.

E. Before submitting proposals, examine the Specifications and Drawings relating to the work and become fully informed as to the extent and character of the work and the relation of the work to that of other sections. Examine the Drawings of other sections to become familiar with all the possible problems and details of the building construction which affect the work.

1.8 SHOP DRAWINGS:

A. Submittals shall comply completely with Section 15010B, Mechanical General Requirements.

B. Submit for review by the Engineer, prior to purchase or installation of equipment, shop drawings of all major equipment and all specially constructed equipment proposed for use in the project. Submittals shall consist of manufacturer's scale drawings, cuts or catalogs, including descriptive literature which shall indicate the construction, material, physical dimensions and complete operating data. All automatic controls shop drawings shall contain a verbal description of the sequence of operations, enumerating and describing the

function of each component.

C. Provide complete catalog cuts, engineering data and other applicable information on all items of equipment. Submittals shall include product bulletins, engineering manuals, application manuals, installation manuals, and commissioning/troubleshooting manuals for all devices.

D. The following submittals are required:

1. System architecture showing all digital devices
2. Well and tap schedule
3. Software descriptions
4. Valves, actuators, and accessories
5. Dampers, actuators, and accessories
6. Control and wiring diagrams of controlled mechanical systems
7. Control unit panels, point layouts, and addresses
8. Sensor and transmitter wiring diagrams
9. Starter and interlock wiring diagrams
10. Sequences of operation
11. Material lists with part numbers, quantities and descriptions
12. Technical data sheets for each piece of equipment
13. As-built drawings with interconnecting wiring diagrams or wire lists of the complete field installed system with complete, properly identified ordering numbers of each system component and device.
14. Operator's manual(s) with pictures and step-by-step operating procedures. This manual shall be indexed and shall have a separate tabbed section for each operator function.
15. Trunk cable schematic showing remote unit locations and all trunk data conductors.

1.9 SYSTEM COMMISSIONING AND ACCEPTANCE PROCEDURE:

A. Submittal data relevant to point index, functions, sequences, interlocks, and associated parameters, and other pertinent information for the operating system and data base shall be forwarded from the Contractor to the Owner. Prior to full operation, a complete demonstration of the system operation shall be performed in the presence of the Owner and the Engineer. This demonstration, having satisfactorily met previously approved submittals, shall, with the Owner's written acceptance, allow commissioning of the system. Upon successful completion of system operation, the Owner and Engineer shall be requested, in writing, to inspect and approve the satisfactory operation of the system, sub-systems, and accessories. Upon completion of the installation, the System contractor shall start up the system and perform all necessary testing and debugging operations. An acceptance test in the presence of the Owner's representative and the Engineer shall be performed. When the system performance is deemed satisfactory in whole or in part by the observers, the system parts will be accepted for beneficial use and placed under warranty.

B. Upon receipt of a detailed punchlist from the Owner, an installation inspection report shall prepared by the System Contractor showing, by system, each outstanding item on the punchlist. After all items appearing on the installation inspection report are completed, a second written request for system approval shall be made to the Owner. As each or all items are approved, an appropriate notation shall be entered at the time of joint inspection on the system report.

C. Problems which occur within approved hardware or software shall be corrected in an appropriate fashion under warranty. Any such occurrence shall not void previous approval; however, the System Contractor shall be responsible to attend to and remedy such items within the warranty period. Appropriate logs, schedules and reports shall be maintained to reflect these items and their redress.

1.10 OWNER'S INSTRUCTION: See Part 3 - Execution.

1.11 SHIPPING TAG: Each component shall be tagged at the factory with its specific location on the job, including FCU designation, building floor, room/area served, and the unit designation shown on the Drawing.

1.12 NAMEPLATES: Provide nameplate on each component as required by Section 15035B - Mechanical Identification.

1.13 QUALITY ASSURANCE:

A. The building level supplier shall be responsible for complete installation, including the proper operation of the system which also includes debugging of all software and calibration of all devices. The building level supplier shall be in the business of design, installation, and service of the building DDC system similar in size and complexity of this project.

B. The building level supplier shall be properly licensed in the following disciplines. Electrical Contracting with an Unlimited classification and Mechanical Contracting with an H-1 and H-2 class 1 classification.

C. All equipment supplied by the building level supplier shall be new. The equipment and materials shall be cataloged products of manufactures regularly engaged in the production and installation of HVAC control systems. Products shall be the manufacturer's latest standard design and have been tested and proven in actual use.

D. The factory branch office supplier shall have a minimum of five years experience in the design and installation of computerized DDC building systems similar in performance to the system specified.

1.14 WARRANTY:

A. The control system herein specified shall be free from defects in material and workmanship under normal use and service for a period of twelve (12) months after final inspection and acceptance by the Owner, under the provisions of Section 15010B.

B. If within the twelve (12) month period, any equipment, software, or labor is found to be defective in workmanship or materials, it shall be replaced or corrected free of charge by the FMS Controls Contractor.

C. Factory authorized warranty service shall be required within 100 miles of jobsite, 24 hours per day, 7 days per week.

PART 2 - PRODUCTS

2.1 SYSTEM ARCHITECTURE:

A. Second Tier Network:

1. Second tier networks shall provide either "Peer-to-Peer," Master-Slave, or Supervised Token Passing communications, and shall operate at a minimum communication speed of 9600 baud.

2. DDC System Controllers shall reside on the second tier.

B. Operator Interface: The FMS Contractor shall extend the existing personal computer workstation for command entry, information management, network alarm management, and database management functions. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the FMS controllers to facilitate greater fault tolerance and reliability.

2.2 APPLICATION SPECIFIC CONTROLLERS:

A. Fan Coil Units (FCU):

1. Each Fan Coil Unit (FCU) controller shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each FCU controller shall be a microprocessor-based, multi-tasking, real-time digital control processor.

2. FCU controllers shall support, but not be limited to, the following configurations of systems to address current requirements as described in the “Execution” portion of this Specification, and to address future expansion:

   a. Fan Coil Units:

      (1) Mixed Air-Single Path
      (2) Mixed Air-Dual Path
      (3) 100% Single Path
      (4) 100% Dual Path

3. Each FCU controller shall have sufficient memory to support its own operating system and databases, including:

   a. Control Processes
   b. Energy Management Applications
   c. Operator I/O (Portable Service Terminal)

4. Point Types: Each FCU controller shall support the following types of point inputs and outputs:

   a. Analog inputs shall monitor the following analog signals:

      (1) 4-20 mA Sensors
      (2) 0-10 VDC Sensors
      (3) 1000ohm RTDs

   b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”

   c. Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.

   d. Analog outputs shall provide the following control outputs:

      (1) 4.20 mA – Sink or Source
      (2) 0-10 VDC

   e. Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays. Inductive loads (i.e. solenoids) shall be controlled by pilot relays.

   f. TriState outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays.

5. Manual Overrides:

   a. Manual override switches shall be provided for all binary outputs that do not have a MCC Hand/Off/Auto switch.

   b. Switches shall be mounted within the system controller key-accessed enclosure, or the adjacent local control panel.

   c. Switches for analog outputs shall be rotary gradual position, providing the full analog signal range of the associated analog output, and shall be operable whether the panel processor is operational or not.

6. FCU controllers shall have a library of control routines and program logic to perform the sequence of operations specified in the “Execution” portion of this Specification.

7. FCU controllers shall directly support the temporary use of a portable service

terminal that can be connected to the FCU via zone temperature or directly at the controller.

8. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the FCU.

B. VAV Terminal Unit Controllers (VAV):

1. Each VAV Controller shall operate as a standalone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each VAV Controller shall be a microprocessor-based, multi-tasking, real-time digital control processor.

2. VAV Terminal Unit Controllers shall support, but not be limited to, the control of the following configurations of VAV boxes to address current requirements described in the “Execution” portion of this Specification, and to address future expansion:

a. Dual Duct (Variable Volume)

3. Point types: Each VAV controller shall support the following types of point inputs and outputs:

a. Analog inputs shall monitor the following analog signals:

(1) 0-10 VDC Sensors
(2) 1000ohm RTDs

b. Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”

c. Counter inputs shall monitor dry contact pulses with an input resolution of one HZ minimum.

d. Analog outputs shall provide the following control outputs:

(1) 0-10 VDC

e. Binary outputs shall provide SPDT output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays. Inductive loads (i.e. solenoids) shall be controlled by pilot relays.

f. TriState outputs shall be paired binary outputs for use as Power Close/Power Open control output contacts rated for 2 amps at 24 VAC. Surge and noise suppression shall be provided on all pilot relays.

4. VAV Controllers shall have a library of control routines and program logic to perform the sequence of operations specified in the “Execution” portion of this Specification.

5. VAV Controllers shall directly support the temporary use of a portable service terminal that can be connected to the VAV via zone temperature or directly at the controller.

6. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the VAV.

2.3 INPUT DEVICES:

A. General Requirements: Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors:

1. General Requirements:

a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.

b. The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.

c. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	Accuracy
Chilled Water	+ .5°F.
Room Temp	+ .5°F.
Duct Temperature	+ .5°F.
All Others	+ .75°F.

2. Room Temperature Sensors: Room sensors shall be constructed for recessed mounting.

3. Thermowells:

a. When thermowells are required, the sensor and well shall be supplied as a complete assembly, including well head and Greenfield fitting.

b. Thermowells shall be pressure rated and constructed in accordance with the system working pressure.

c. Thermowells and sensors shall be mounted in a threadolet or 1/2” NFT saddle and allow easy access to the sensor for repair or replacement.

d. Thermowells shall be constructed of 316 stainless steel.

4. Duct Mount Sensors:

a. Duct mount sensors shall mount in an electrical box through a hole in the duct, and be positioned so as to be easily accessible for repair or replacement.

b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.

c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

5. Averaging Sensors:

a. For ductwork greater in any dimension that 48 inches and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.

b. For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.

c. Capillary supports at the sides of the duct shall be provided to support the sensing string.

6. Carbon Dioxide Sensor: Vaisala GMD20 single beam, dual wave length, sensor with display, or Engineer approved equivalent.

7. General Air and Water Pressure Transmitter Requirements:

   a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.

   b. Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.

   c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device, and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Owner permanent, easy-to-use connection.

   d. A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

C. Smoke Detectors: Ionization type air duct detectors shall be furnished as specified elsewhere in Division 16 for installation under Division 15. All wiring for air duct detectors shall be provided under Division 16, Fire Alarm System.

D. Status and Safety Switches:

1. General Requirements: Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the FMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

2. Current Sensing Switches:

   a. The current sensing switch shall be self-powered with solid state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.

   b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.

   c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

   d. Acceptable manufacturers: Veris Industries

3. Air Filter Status Switches:

   a. Differential pressure switches used to monitor air filter status shall be of the automatic reset type with SPDT contacts rated for 2 amps at 120VAC.

   b. A complete installation kit shall be provided, including: static pressure tops, tubing, fittings, and air filters.

   c. Provide appropriate scale range and differential adjustment for intended service.

4. Air Flow Switches: Differential pressure flow switches shall be bellows actuated mercury switches or snap acting micro-switches with appropriate scale range

and differential adjustment for intended service.

5. Air Pressure Safety Switches:

   a. Air pressure safety switches shall be of the manual reset type with SPDT contacts rated for 2 amps at 120VAC.

   b. Pressure range shall be adjustable with appropriate scale range and differential adjustment for intended service.

6. Low Temperature Limit Switches:

   a. The low temperature limit switch shall be of the manual reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.

   b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.

   c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

2.4 OUTPUT DEVICES:

A. Actuators:

1. General Requirements: Damper and valve actuators shall be electronic as specified in the System Description section.

2. Electronic Damper Actuators:

   a. Electronic damper actuators shall be direct shaft mount.

   b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.

   c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication. The feedback signal of one damper actuator for each separately controlled damper shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

   d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as "quick acting," shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.

3. Electronic Valve Actuators:

   a. Electronic valve actuators shall be manufactured by the valve manufacturer.

   b. Each actuator shall have current limiting circuitry incorporated in its design to prevent damage to the actuator.

   c. Modulating and two-position actuators shall be provided as required by the sequence of operations. Actuators shall provide the minimum torque required for proper valve close-off against the system pressure for the required application. The valve actuator shall be sized based on valve manufacturer's recommendations for flow and pressure differential. All actuators shall fail in the last position unless specified with mechanical spring return in the sequence of operations. The spring return feature shall permit normally open or normally closed positions of the valves, as required. All direct shaft mount rotational actuators shall have external adjustable stops to limit the travel in either direction.

   d. Modulating Actuators shall accept 24 VAC or VDC and 120 VAC power supply and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal, and may be used to parallel other actuators and provide true position indication. The feedback signal of each valve actuator (except terminal valves) shall be wired back to a terminal strip in the control panel for trouble-shooting purposes.

   e. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Butterfly isolation and other valves, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop the associated pump or chiller.

B. Control Dampers:

1. The FMS Contractor shall furnish all automatic dampers not provided by unit manufacturer. All automatic dampers shall be sized for the application by the FMS Contractor or as specifically indicated on the Drawings.

2. All dampers used for throttling airflow shall be of the opposed blade type arranged for normally open or normally closed operation, as required. The damper is to be sized so that, when wide open, the pressure drop is a sufficient amount of its close-off pressure drop to shift the characteristic curve to near linear.

3. All dampers used for two-position, open/close control shall be parallel blade type arranged for normally open or closed operation, as required.

4. Damper frames and blades shall be constructed of either galvanized steel or aluminum. Maximum blade length in any section shall be 48". Damper blades shall be 16-gauge minimum and shall not exceed six (6) inches in width. Damper frames shall be 16-gauge minimum hat channel type with corner bracing. Additional stiffening or bracing shall be provided for any section exceeding 48" in height. All damper bearings shall be made of stainless steel or oil-impregnated bronze. Dampers shall be tight closing, low leakage type, with synthetic elastomer seals on the blade edges and flexible stainless steel side seals. Dampers of 48"x48" size shall not leak in excess of 8.5 cfm per square foot when closed against 4" w.g. static pressure when tested in accordance with AMCA Std. 500.

5. Air foil blade dampers of double skin construction with linkage out of the air stream shall be used whenever the damper face velocity exceeds 1500 FPM or system pressure exceeds 2.5" w.g., but no more than 4000 FPM or 6" w.g.

Acceptable manufacturers are Johnson Controls D-1300, Ruskin CD50, and Vent Products 5650.

6. One piece rolled blade dampers with exposed or concealed linkage may be used with face velocities of 1500 FPM or below.

7. Acceptable manufacturers are: Johnson Controls D-1100, Ruskin CD36, and Vent Products 5800.

8. Multiple section dampers may be jack-shafted to allow mounting of piston pneumatic actuators and direct connect electronic actuators. Each end of the jack shaft shall receive at least one actuator to reduce jack shaft twist.

C. Control Relays:

1. Control Pilot Relays:

a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.

b. Mounting bases shall be snap-mount.

c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.

d. Contacts shall be rated for 10 amps at 120VAC.

e. Relays shall have an integral indicator light and check button.

D. Control Valves:

1. All automatic control valves shall be fully proportioning and provide near linear heat transfer control. The valves shall be quiet in operation and fail-safe open, closed, or in their last position. All valves shall operate in sequence with another valve when required by the sequence of operations. All control valves shall be sized by the control manufacturer, and shall be guaranteed to meet the heating and cooling loads, as specified. All control valves shall be suitable for the system flow conditions and close against the differential pressures involved. Body pressure rating and connection type (sweat, screwed, or flanged) shall conform to the pipe schedule elsewhere in this Specification.

2. Chilled water control valves shall be modulating, ball, and/or butterfly, as required by the specific application. Modulating water valves shall be sized per manufacturer’s recommendations for the given application. In general, valves (2 or 3-way) serving variable flow air handling unit coils shall be sized for a pressure drop equal to the actual coil pressure drop, but no less than 5 PSI.

3. Ball valves shall be acceptable for water terminal reheat coils, radiant panels, unit heaters, package air conditioning units, and fan coil units.

4. Butterfly valves shall be acceptable for modulating large flow applications greater than modulating plug valves, and for all two-position, open/close applications. In-line and/or three-way butterfly valves shall be heavy-duty pattern with a body rating comparable to the pipe rating, replaceable lining suitable for temperature of system, and a stainless steel vane. Valves for modulating service shall be sized and travel limited to 50 degrees of full open. Valves for isolation service shall be the same as the pipe. Valves in the closed position shall be bubble-tight.

2.5 MISCELLANEOUS DEVICES:

A. Local Control Panels:

1. All control panels shall be factory constructed, incorporating the FMS manufacturer’s standard designs and layouts. All control panels shall be UL

inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with sub-panel, hinged door, and key-locking latch.

2. In general, the control panels shall consist of the DDC controller(s), display module, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. The display module shall be flush mounted in the panel face unless otherwise noted.

3. All I/O connections on the DDC controller shall be extended to a numbered, color-coded, and labeled terminal strip for ease of maintenance and expansion. Wiring to I/O devices shall be made from this terminal strip.

4. All other wiring in the panel, internal and external, shall be made to additional line or low voltage color-coded and labeled terminal strips. Low and line voltage wiring shall be segregated. All terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.

5. All wiring for every control panel shall follow a common color-coded format. All terminal strip color coding and numbering shall follow a common format. All wiring shall be neatly installed in plastic trays or tie-wrapped.

6. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

PART 3 - EXECUTION

3.1 INSTALLATION PRACTICES:

A. HVAC Control System Wiring:

1. All conduit, wiring, accessories and wiring connections required for the installation of the Facility Management System, as herein specified, shall be provided by the FMS Contractor unless specifically shown on the Electrical Drawings under Division 16 Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.

2. All system input wiring shall be twisted shielded pair, minimum 18 gauge wire. All system analog output wiring shall be twisted shielded pair/3-wire as required, minimum 18 gauge wire. Preconfigured cables between Terminal Unit Controllers and Thermostats are acceptable, minimum 24 gauge.

3. All internal panel device wiring for binary outputs and pilot relay shall be minimum 16 gauge wire.

4. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.

a. Class 2 wiring not installed in conduit shall be supported every 5’ from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements. Exposed wiring shall only be allowed in concealed accessible locations.

5. All wiring in mechanical rooms shall be in conduit. Minimum control wiring conduit size 3/4”.

3.2 INSPECTION AND PREPARATION:

A. Prior to executing the work, carefully inspect the installed work of other trades and verify

that all such work is complete and to the point where the control systems may be installed without damage. Coordinate with other trades.

B. Verify that conditioned power supply is available to control units and operator workstation. Verify that field end devices, wiring, and pneumatic tubing are installed before proceeding with installation.

3.3 INSTALLATION: All work shall be installed in strict accordance with the Drawings and Specifications by personnel directly in the employ of the Controls Contractor or his subcontractors.

A. Install equipment as indicated to comply with manufacturer's written instructions.

B. Install software in control units and operator workstation. Implement all features of programs to specified requirements and appropriate to sequence of operation.

C. Connect and configure equipment and software to achieve the sequence of operation specified.

D. Verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate 60 inches (1524 mm) above floor.

1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

E. Install damper motors on outside of duct in warm areas, not where exposed to outdoor temperatures.

F. Install labels and nameplates to identify control components according to Division 15 Sections specifying mechanical identification.

G. Install hydronic instrument wells, valves, and other accessories according to Sections 15010B and 15060B.

H. Install duct volume-control dampers according to Section 15840B - Ductwork.

3.4 ELECTRICAL: The control system shall be installed according to the following provisions. All electrical work shall be installed in accordance with Division 16 - Electrical.

A. Power wiring for the control system and smoke detectors shall be provided by the Electrical Contractor. Designated circuit breakers shall be furnished by the Electrical Contractor in the distribution panelboards for the control systems. Feeders shall be run to junction boxes by the Electrical Contractor as shown on the plans and control diagrams.

B. All limited energy cable installed under this specification shall be UL listed and labeled for the specific use.

C. All wiring shall be in conduit. (All Junction Box covers shall have the word "CONTROLS" painted on them -- 3/8" high or larger.)

D. All electrical wiring shall comply with the National Electrical Code, Project Specifications, and shall be installed by licensed journeyman electricians.

E. Low voltage and line voltage wiring shall be installed in separate conduits.

F. All interlock and control wiring for the HVAC systems not shown on the Electrical Drawings shall be by the FMS Controls Contractor. This may include but not be limited to:

1. Sensor and transmitter wiring to DDC panels.

2. Safety interlocks to the starters, i.e. low and high pressure safety switches, smoke detector shut-down contacts, start/stop functions, and limit controls.

3. Wiring of thermostats or factory prewired panels furnished by others to control fans, and the like.

4. Trunk communication wiring.

G. Signal and Communication Cable:

1. Bundle and harness multiconductor instrument cable in place of single cables where a number of cables follow a common path.

2. Fasten flexible conductors, bridging cabinets and doors, neatly along hinge side; protect against abrasion. Tie and support conductors neatly.

3. Number-code or color-code conductors, except local individual room controls, for future identification and servicing of control system.

H. Connect electrical components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

I. Connect manual reset limit controls independent of manual control switch positions.

J. Connect HAND-OFF-AUTO selector switches to override automatic interlock controls when switch is in HAND position.

K. Conduit:

1. Conduit Supports:

a. Single runs shall use galvanized conduit straps or ring bolt type hangers with specialty spring clips. Plumber's perforated straps are not allowed.

b. Multiple runs shall use conduit racks with 25% spare capacity.

c. Vertical runs shall use channel support with conduit fittings.

2. Anchor Methods:

a. Hollow masonry shall have toggle bolts or spider type expansion anchors.

b. Solid masonry shall have lead expansion anchors or preset inserts.

c. Metal surfaces shall have machine screws, bolts, or welded studs.

d. Wood surfaces shall have wood screws.

e. Concrete surfaces shall have self-drilling anchors or power drive studs.

L All conduit, wiring, accessories, and wiring connections required for the installation of the Facility Management System, as herein specified, shall be provided by the FMS Contractor unless specifically shown on the Electrical Drawings under Division 16 - Electrical. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.

M. All system input wiring shall be twisted shielded pair, minimum 18 gauge wire. All system analog output wiring shall be twisted shielded pair/3-wire as required, minimum 18 gauge wire. Preconfigured cables between Terminal Unit Controllers and Thermostats are acceptable, minimum 24 gauge.

N. All internal panel device wiring for binary outputs and pilot relay shall be minimum 16 gauge wire.

O. All Class 2 (24VAC or less) wiring shall be installed in conduit unless otherwise specified.

a. Class 2 wiring not installed in conduit shall be supported every 5’ from the building structure utilizing metal hangers designed for this application. Wiring shall be installed parallel to the building structural lines. All wiring shall be installed in accordance with local code requirements. Exposed wiring shall only be allowed in concealed accessible locations.

P. All wiring in mechanical rooms shall be in conduit. Minimum control wiring conduit size 3/4”.

3.5 WIRING SUPERVISION AND CHECKOUT: Supervision and checkout of the system shall be by factory trained engineers and technicians directly employed by the FMS Controls Contractor.

3.6 INSTRUCTIONS AND MANUALS:

A. Upon completion of the project, the Controls Contractor shall have completely adjusted and calibrated the entire control system to operate as described in this section of the Specifications before beginning Demonstration and Training.

B. Demonstration and Training: Provide the services of a factory-authorized service representative for a minimum of 12 hours to demonstrate and train Owner's maintenance personnel as specified below. The Owner reserves the right to replace any instructor who, in their opinion, does not demonstrate sufficient qualifications.

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

2. Schedule training with Owner with at least 7 days' notice.

3. Provide operator training on data display, alarm and status descriptors, requesting data, execution of commands, and request of logs and turn over to the owner all LonWorks and Lon Mark address and binding codes.

C. The Contractor shall obtain from the Owner a signed receipt that Owner's personnel have received complete instruction on the operation of the system.

D. Manuals: The Contractor shall submit to the Owner's representative four (4) sets of as-built drawings, and operating and maintenance manuals, to be approved and delivered to the Owner, as follows:

1. Operators Manuals with explanations of operator functions. Although operator functions are to be self-instructional and menu-interactive from the keyboard terminal, this manual shall be for off-line study and refresher use.

2. Computerized printouts of all data file construction including all point processing assignments, physical terminal relationships, flowcharts of graphic program, etc.

3. Manuals including revised as-built documents of all materials required under the Part 1 paragraph "Shop Drawings" in this Specification Section.

4. A user manual for the integrated spreadsheet package (only one required).

E. The Contractor shall obtain from the Owner's representative a signed receipt that he has received the drawings and manuals.

3.7 COMMISSIONING: Commissioning the Facility Management System is a mandatory documented performance requirement of the selected FMS Contractor for all control systems detailed in this Specification and sequence of operations. Commissioning shall include verification of proper installation practices by the FMS Contractor and subcontractors under the FMS Contractor, point verification and calibration, system/sequence of operation verification with respect to specified operation, and network/workstation verification. Documentation shall be presented upon completion of each commissioning step and final completion to ensure proper operation of the Facility Management System.

A. Acceptance Check List: An acceptance checklist shall be completed that documents

compliance with each item of this Specification.

B. Testing Procedure: Upon completion of the installation, the FMS Contractor shall start-up the system and perform all necessary testing and run diagnostic tests to ensure proper operation. The FMS Contractor shall be responsible for generating all software and entering all database information necessary to perform the sequences of control herein specified.

C. Testing Documentation: Prior to acceptance testing, FMS Contractor shall create, on an individual system basis, trend logs of input and output points, or have an automatic Point History feature for documentation purposes.

D. Field Points Testing:

1. This step shall verify that all of the installed points receive or transmit the correct information prior to loading/activating the system software.

2. ON/OFF commands from the workstation shall be performed in order to verify each binary output point.

3. All binary input points are to be tested using the HAND/OFF/AUTOMATIC selector switch on the associated motor control center or by manually jumpering across the field device contacts.

4. All analog output points providing pneumatic output control shall be tested using a command from the workstation to modulate the output from minimum calibrated signal to maximum calibrated signal. Analog Output values to Pneumatic transducers shall be displayed so that a 0 percent display value corresponds to the pressure required to set the pneumatic actuator to minimum position, and a 100 percent display value corresponds to the pressure required to set the pneumatic actuator to the maximum position.

5. All analog output points shall be tested using a command from the workstation to modulate the output device from minimum calibrated signal to maximum calibrated output.

6. All analog input points are to be tested by comparing the reading obtained through the workstations or portable terminal to the value of an independent testing meter.

E. VAV box performance verification and documentation:

1. As part of the commissioning of the terminal unit control and air distribution system, the Contractor shall initiate an automated test where the dampers in one half of a group of boxes are stepped towards full open while the other half are stepped towards full closed. At each step, after a settling time, box airflows and damper positions will be sampled. Following the cycle, a pass/fail report indicating results shall be produced. Possible results are Pass, No change in flow between full open and full close, Reverse operation, or Maximum flow not achieved. The report shall be submitted as documentation of the installation.

2. The Controls Contractor shall issue a report based on a sampling of the VMA calculated loop performance metrics. The report shall indicate performance criteria, include the count of conforming and non-conforming boxes, list the non-conforming boxes along with their performance data, and shall also include graphical representations of performance. The sampling shall take place after completion of Test and Balance, when design cooling and heating media have been available and occupied conditions approximated for five consecutive days.

F. Noncompliant Items: The Contractor shall remove and replace, at its expense, all items that are not in compliance with the Specification requirements.

3.8 SEQUENCES OF OPERATION:

A. General:

1. Refer to Flow & Control Diagram Drawings for additional requirements.

2. Smoke detectors shall be wired to the Fire Alarm Control Panel (FACP) by the Electrical Contractor. SPDT shut-down relays from the FACP, provided by the Electrical Contractor in the area of air handling equipment starters, shall be wired to the starters by the Controls Contractor. See Electrical Drawings and Section 15010B.

3. The Controls Contractor shall be responsible for furnishing all dampers that are not expressly specified to be furnished by another contractor or supplier.

4. The term "Sensor Failure" is defined as a short circuit, an open circuit, or an unreal value.

B. Fan Coil Unit (FCU) Sequence of Operation:

1. Provide a factory mounted toggle type electrical disconnect switch with each unit.

2. Provide a factory mounted temperature controller and a thermostat with each unit. Thermostat shall be unit mounted or wall mounted as scheduled.

3. The thermostat shall have and LCD display, a temperature adjustment for room temperature control, and an occupancy override switch to initiate the unit during unoccupied times. Thermostat shall be capable of a 5 degree dead band between heating and cooling as required by NC Energy Code.

4. The fan speed shall be controlled by the DDC controller at the lowest speed required to provide the required to meet the heating or cooling setpoint.

5. The fan shall operate continuously when set to low, medium or high speed and the control valves shall be activated to provide cooling or heating.

6. A high level switch shall be hard wired to disable the unit, indicate an alarm, disable the unit supply fan and close the chilled water control valve in the event of condensate pan high level.

7. The unit controls shall be monitored and configured remotely thru the Owners facility management system. This shall include at least the following:

a. Run enable for occupied and unoccupied modes
b. Monitor room temperature
c. Monitor unit high level condensate alarm
d. Monitor unit cooling or heating status
e. Configure cooling low and high setpoint limits
f. Configure heating low and high setpoint limits
g. Configure low room temp setpoint limit
h. Configure alarms for each setpoint

8. Interlocks:

a. A shutdown relay wired from the Fire Alarm Control Panel (FACP) shall de-energize the control circuit of the supply fan.

b. A low limit temperature switch (adjustable setpoint) shall stop the supply fan if the mixed air temperature entering the cooling coil drops below 35 deg. F (manual reset). This safety shall be directly wired into the starter circuit.

c. A low limit duct pressure sensor cutout shall stop the supply fan if the suction side duct pressure drops below setpoint (manual reset).

d. A high limit duct pressure sensor cutout shall stop the supply fan if the discharge duct pressure increases above maximum setpoint (manual reset). This safety interlock shall be directly wired into the starter circuit.

9. Miscellaneous: A filter gauge station shall be provided to monitor the pressure drop of each filter section.

C. Dual Duct Terminal Units:

1. Cooling and Heating: When the space temperature is warm, the cold damper is maintaining the maximum cooling airflow setpoint while the hot damper is closed. As space temperature drops, the cold air flow modulates from maximum to minimum flow rate. As the space temperature continues to fall, the hot damper modulates open. As temperature continues to drop, hot damper will open to maximum heating flow to maintain setpoint. On a rise in temperature, the reverse shall occur.

END OF SECTION 15900B

SECTION 16010 - ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE:

A. General Conditions of the Contract, Special Conditions, and Instructions to Bidders contained herein are a part of these specifications.

B. This Contractor shall furnish all labor, materials and equipment and perform all operations necessary for installation of complete electrical work within the intent of, and as indicated on, the Drawings and as specified herein.

1.2 DEFINITIONS:

A. The word "Contractor" as used in this section of the specification refers to the Electrical Contractor unless specifically noted otherwise.

B. The word "provide" means furnish completely installed, including labor and incidental materials necessary for operation or use the item referred to or described herein and/or shown or referred to on the Contract Drawings.

1.3 CONTRACTOR'S MISCELLANEOUS RESPONSIBILITIES:

A. The Contractor shall provide in his work, without extra cost to the Owner, any labor, materials, service, apparatus, drawings, in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on the Drawings and/or specified.

B. The right to make any responsible change in location of apparatus or equipment or routing of conduit prior to the time of roughing in, is reserved by the Owner without involving any additional expense to the Owner. The Owner reserves the right to relocate any receptacle outlet + 10'-0" up to the time roughing-in at no additional expense.

C. Coordination Issues:

1. The Contractor shall coordinate his schedule of work with the Owner and other contractors, and shall plan his work to minimize disruption to the Owner's use of this facility.

2. Contractor shall effect cooperation between his employees and those of Owner and Contractors on work awarded separately by the Owner, to the end that all work is properly anchored, installed and finished without hindrance or delay. Care shall be taken to avoid marring surfaces of the work of other Contractors, and each Contractor shall be held responsible for any damage to the work of others. Repair of new work shall be made by the original Contractor at the expense of the Contractor responsible for the damage.

D. Protection of Equipment and Facility: The Contractor shall have the responsibility of protecting the Owner's equipment, stored materials, fixtures, piping, conduit, and other building components and finishes at all times during the construction and shall replace and/or repair any damage that is a result of his construction activities.

E. Working Hours: Working days and hours shall be as scheduled in Division 1.

F. Contractor Supervisor: The Contractor shall assign and maintain a single qualified person as a job superintendent on this project. The superintendent shall not be responsible for duties or projects other than those required to complete the scope of work required on the construction documents.

G. Safety: The Contractor shall be responsible for initiating, maintaining, and supervising all safety measures and precautions and programs in connection with the work as required to meet all the safety standards of the governing agencies.

1.4 CONTRACT DOCUMENTS:

A. The Contract Drawings and Specifications are intended to depict the scope of work required. However, the drawings are schematic and diagrammatic and do not depict every item of material and equipment required to accomplish the work.

B. Contractor shall maintain on the job site one complete set of contract documents of all trades, and shall coordinate with other trades so as to avoid conflicts.

C. Indicated locations of equipment, boxes, etc. are approximate and shall be verified by the Contractor and shall be coordinated with the Owner's representative.

1.5 RECORD DRAWINGS: Contractor shall prepare drawings showing proposed rearrangement of work to meet job conditions, including changes to work specified under other sections. Obtain permission of Owner before proceeding.

1.6 REFERENCES:

A. ANSI/IEEE C2 - National Electrical Safety Code

B. ANSI/NFPA 70 - National Electrical Code

C. NECA - Standard of Installation 16, in addition to Division 1 provisions.

1.7 REGULATORY REQUIREMENTS:

A. Conform to ANSI/NFPA 70

B. Conform to ANSI/IEEE C2

C. Conform to local Building Codes.

D. Obtain electrical permits, plan review, and inspections from authority having jurisdiction.

1.8 SUBMITTALS:

A. Contractor shall submit inspection and permit certificates under provisions of Division 1.

B. Bid Submittals:

1. The Contractor shall study all Contract Documents to determine any conflicts or discrepancies of items which, in the opinion of the Contractor, are not clear. All errors or omissions shall be reported to the Owner's representative for clarification prior to bid submittal. No additional cost to the Owner shall result by Contractor's failure to request clarification on any item.

2. Submittal of bid shall indicate the Contractor has examined the site, Drawings and Specifications and has included all required allowances in his bid. No allowance shall be made for any error resulting from Contractor's failure to visit job site and to review Drawings and Specifications. Bid shall include costs for all required changes including record drawing changes and all shop drawings.

3. Before bid submittals are made, the Contractor shall determine that specified materials availability shall not delay progress of the work. If undue delays or other major circumstances are foreseen, the Contractor must alert the Owner's representative immediately and before submittal of his bid.

4. Contractor's base bid shall include only those Manufacturers and equipment types called for in the Specifications or on the Drawings. If a specific Manufacturer is not listed, the Contractor may submit other manufacturers and equipment types as outlined in Section 10631.

C. Equipment Submittals, Shop Drawings, Record Drawings: Shall be submitted in accordance with Division 1.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT:

A. All materials and equipment shall be new, undamaged and top quality. They shall be so-selected and arranged as to fit properly and fulfill their intended purpose.

B. Materials and equipment shall bear the manufacturers label, marking or name tag, whichever is applicable, giving pertinent information.

C. Materials and equipment shall be inspected upon arrival at the site, to insure they are correct. Adequate facilities shall be provided on-site for orderly and protective storage of all materials and equipment.

D. Materials and equipment shall be as given in these Specifications or on the Drawings except that if Contractor proposes to furnish an alternate, he shall furnish complete, detailed information to the Owner and obtain written approval for the substitution within 10 days after award of contract. Where materials and equipment are not specified, they shall be acceptable, or not acceptable, as determined by the authority having jurisdiction.

E. Where these Specifications or the Construction Drawings identify materials or equipment by a catalog number, it shall be understood that all parts of that material or equipment which are necessary for the complete working installation shall be included. For example, motor starters shall be furnished with overload heaters.

PART 3 - EXECUTION

3.1 WORKMANSHIP:

A. Contractor shall install work using procedures defined in NECA Standard of Installation.

B. The Contractor shall furnish the services of an experienced superintendent, who shall be constantly in charge of the construction. All work shall be done by experienced workmen, properly supervised.

3.2 OBSERVATION: The project will be observed periodically as construction progresses. The Contractor will be responsible for notifying the Owner at least 24 hours in advance when any work to be covered up is ready for inspection. No work will be covered up until after observation has been completed.

3.3 PAINTING, FINISHING:

A. Suitable finishes shall be provided on all items of electrical equipment, conduit, etc. which are exposed. This shall consist of either an acceptable finish as manufactured and supplied to the job or application of suitable finishes after installation.

B. Where installed in finished areas, exposed equipment, raceways, panel covers, etc. shall be supplied with prime coat, and shall be professionally painted or enameled as directed to match or blend with adjacent surfaces.

C. In unfinished areas, such as equipment rooms, etc., exposed equipment shall be furnished with suitable factory applied finish.

D. Equipment furnished in finishes such as stainless steel, brushed aluminum, etc. shall not be painted.

E. All finishing shall be as directed by and satisfactory to the Owner.

3.4 EQUIPMENT LABELS, ETC.:

A. Suitable nameplates shall be provided for the identification of major items of electrical

equipment including panelboards, safety switches, enclosed circuit breakers, etc.

B. Nameplates shall be of engraved plastic laminate, not less than 1/16" thick.
C. Engraving shall be of professional quality, with block style letters, minimum 1/4" high.

D. Nameplates shall be attached with pop rivets or with epoxy glue.

3.5 FOUNDATIONS, SUPPORTS, PIERS, ATTACHMENTS:

A. This Contractor shall furnish and install all necessary foundations, supports, pads and piers required for all equipment furnished under this contract.

B. All equipment, unless otherwise shown, shall be securely attached to the building structure in an approved manner.

3.6 ACCEPTANCE, TESTS, AND GUARANTEE:

A. Upon completion of work, Contractor shall demonstrate and make such tests as may be required to satisfy Owner that construction is in accordance with Drawings, Specifications and instructions.

B. In the event that the Owner considers it impractical, because of unsuitable test conditions, or some other factors, to execute simultaneous final acceptance of all equipment, portions of the installation may be certified by the Owner for final acceptance when that portion of the system is complete and ready for operation.

C. Contractor shall guarantee the work done in accordance with Drawings and Specifications, and to be free of defective materials and workmanship. Anything unsatisfactory shall be corrected immediately and at Contractor's expense.

D. For a period of one year after acceptance, Contractor shall replace, without any expense to the Owner, any defective materials or workmanship, including any cutting or patching which may be required.

END OF SECTION 16010

SECTION 16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 WORK INCLUDED: Grounding and bonding of the electrical systems.

1.2 SYSTEM DESCRIPTION:

A. The power distribution system shall be grounded at each voltage level. The conduit and neutral conductors of the wiring systems and all electrical equipment shall be grounded.

B. Each conductive, non-current carrying, part of the electrical system shall be bonded to an equipment grounding conductor sized in accordance with NEC, unless otherwise shown on the Drawings.

C. The raceway system shall not be relied on for ground continuity. A green grounding conductor, properly sized per NEC, shall be run in all raceways.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Grounding and bonding conductors; building wire, color green. Refer to Section 16120 and the Drawings.

B. All products shall be new and, wherever possible, UL listed for the use intended.

2.2 ACCEPTABLE MANUFACTURERS OF GROUNDING CONNECTORS:

A. Bolted, Clamp Type or Compression Type:

1. Burndy.
2. OZ.
3. Anderson.
4. Substitutions: Under provisions of Section 01600.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION:

A. Provide a separate, green insulated copper equipment grounding conductor in feeder and branch circuits. Terminate each end on a grounding lug, bus, bushing, etc. to each motor, control, switch, receptacle, junction box, panelboard, lighting fixture, etc.

B. Ground all raceway systems and equipment in accordance with Section 250 of the latest edition of NEC, and in accordance with the Drawings and these Specifications.

C. Boxes with concentric, eccentric or oversized knockouts shall be provided with bonding bushings and jumpers. The jumper shall be sized per NEC Table 250-66 and lugged to the box.

D. Bond together exposed non-current carrying metal parts of electrical equipment, metal raceway system, ground conductor in raceways and cables and receptacle ground connectors.

END OF SECTION 16060

SECTION 16070 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Conduit and equipment supports.

B. Fastening hardware.

1.2 QUALITY ASSURANCE: Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 MATERIAL:

A. Support Channel: Galvanized

B. Hardware: Corrosion resistant

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, beam clamps, and spring steel clips.

B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs.

C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

D. Do not use powder-actuated anchors.

E. Do not drill structural steel members.

F. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

G. Install surface-mounted cabinets and panelboards with minimum of four anchors.

END OF SECTION 16070

SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Nameplates.

B. Wire and cable markers.

C. Conduit color coding.

1.2 RELATED WORK: Painting - Section 16010.

1.3 SUBMITTALS:

A. Submit shop drawings under provisions of Section 16010.

B. Include schedule for nameplates.

PART 2 - PRODUCTS

2.1 MATERIALS:

A. Nameplates: Engraved three-layer laminated plastic, black letters on a white background.

B. Wire and Cable Markers: Cloth markers, split sleeve or tubing type.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Degrease and clean surfaces to receive nameplates.

B. Install nameplates parallel to equipment lines.

C. Secure nameplates to equipment fronts using screws, rivets, or adhesive. Secure nameplate to inside face of recessed panelboard doors in finished locations.

3.2 WIRE IDENTIFICATION: Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power circuits.

3.3 NAMEPLATE ENGRAVING SCHEDULE:

A. Provide nameplates to identify all electrical distribution and loads served.

B. Provide nameplates of minimum letter height as scheduled below.

1. Panelboards: 1/4 inch; identify equipment designation. 1/8 inch; identify voltage rating and source.

2. Individual Circuit Breakers in Panelboards: 1/8 inch; identify circuit and load served, including location.

3. Disconnect Switches: 1/4 inch; identify load and source.

END OF SECTION 16075

SECTION 16080 - ELECTRICAL TESTING

PART 1 - GENERAL

1.1 SCOPE:

A. Provide testing of electrical wiring and systems as specified here.

B. Provide the following tests:

1. Insulation resistance testing

1.2 DOCUMENTATION:

A. All tests specified shall be completely documented indicating time of day, date, temperature, and all pertinent test information.

B. All required documentation of readings indicated above shall be submitted to the Engineer prior to, and as one of the prerequisites for final acceptance of the project.

C. Meet requirements of Section 01700 and 16010.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 FEEDER INSULATION RESISTANCE TESTING:

A. All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500-volt megger. The procedures are listed below.

1. Minimum readings shall be one million (1,000,000) or more ohms for #6 wire and smaller, 250,000 ohms or more for #4 wire or larger, between conductors and between conductor and the grounding conductor.

2. After all fixtures, devices, and equipment are installed and all connections completed to each panel, the Contractor shall disconnect the neutral feeder conductor from the neutral bar and take a megger reading between the neutral bar and the grounded enclosure. If this reading is less than 250,000 ohms, the Contractor shall disconnect the branch circuit neutral wires from this neutral bar. He shall than test each one separately to the panel and until the low readings are found. The Contractor shall correct troubles, reconnect and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.

3. The Contractor shall send a letter to the Engineer certifying that the above has been done and tabulating the megger readings for each panel. This shall be done at least four (4) days prior to final inspection.

4. At final inspection, the Contractor shall furnish a megger and show the Engineers that the panels comply with the above requirements. He shall also furnish a hook-on type ammeter and a voltmeter and take current and voltage readings as directed by the representative.

END OF SECTION 16080

SECTION 16120 - CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Building wire and single conductor cable.

B. Multi-conductor cable and cords.

C. Wiring connections and terminations.

1.2 REFERENCES:

A. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

B. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

C. NEMA WC 7 - Thermoset-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

PART 2 - PRODUCTS

2.1 BUILDING WIRE, CABLES, AND CORDS:

A. Feeders and branch circuits larger than 10 AWG: Stranded copper conductor, 600 volt insulation, THHN/THWN, UL listed.

B. Feeders and branch circuits 10 AWG and smaller: Solid copper conductor, 600 volt insulation, THHN/THWN, UL listed.

C. Cords, Power: Cords for power service shall be portable type, meeting UL requirements and NEMA standards and with 600 volt, 90^{o}C rated thermoset insulation, synthetic rubber jacket and rope stranded copper conductors.

2.2 ACCEPTABLE MANUFACTURERS:

A. Cablec

B. Okonite

C. Southwire

D. Triangle

E. Substitutions: Under provisions of Section 16010.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS:

A. Use no wire smaller than 12 AWG for power, and no smaller than 14 AWG for control wiring.

B. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 50 feet.

C. Place an equal number of conductors for each phase of a circuit in same raceway or cable.

D. Splice only in junction or outlet boxes.

E. Neatly train and fasten wiring inside boxes, equipment, and panelboards.

F. Make conductor lengths for parallel circuits equal.

3.2 WIRING INSTALLATION IN RACEWAYS:

A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant for pulling 4 AWG and larger wires.

B. Completely and thoroughly swab raceway system before installing conductors.

3.3 CABLE INSTALLATION:

A. Provide protection for exposed cables where subject to damage.

B. Use spring metal clips or plastic metal cable ties to support cables from structure. Include bridle rings or drive rings.

C. Use suitable cable fittings and connectors.

3.4 WIRING CONNECTIONS AND TERMINATIONS:

A. Splice only in accessible junction boxes.

B. Joints in solid conductors, namely those sized #10 AWG and smaller, shall be spliced using Ideal "wing-nuts", 3M Co.'s "Scotchlok", or T&B "Piggy" connectors in junction boxes and light fixtures. "Sta-Kon" or other permanent type crimp connectors shall not be used for branch circuit connections.

C. Stranded conductors, namely #8 AWG and larger, shall be spliced by approved mechanical connectors plus gum tape, plus vinyl tape. Solderless mechanical connectors for splices and taps provided with UL approved insulating covers may be used instead of mechanical connectors plus tape.

D. Thoroughly clean wires before installing lugs and connectors.

E. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

F. Terminate spare conductors with electrical tape.

3.5 FIELD QUALITY CONTROL:

A. Inspect wire and cable for physical damage and proper connection.

B. Torque test conductor connections and terminations to manufacturer's recommended values.

C. Perform continuity test on all power and equipment branch circuit conductors. Verify proper phasing connections.

3.6 WIRE AND CABLE INSTALLATION SCHEDULE:

A. Concealed Interior Locations: Building wire in raceways.

B. Exposed Interior Locations: Building wire in raceways.

C. Above Accessible Ceilings: Building wire in raceways.

3.7 COLOR CODING:

A. All wiring shall be color coded.

B. On 120/208V, 3 phase, 4 wire power systems, conductors shall be color coded Black

(Phase A), Red (Phase B), Blue (Phase C), and White (Neutral). One 277/480V, 3 phase, 4 wire power systems, conductors shall be color coded Brown (Phase A), Orange (Phase B), Yellow (Phase C), and Grey (Neutral).

C. Ground conductors on all systems shall be Green.

D. Conductors AWG6 and larger may be identified with two or more bands of proper color plastic tape applied near each termination. Painting of wire will not be acceptable.

E. Unless noted otherwise, or another arrangement is approved by the Owner, busses in panels and switch gear shall be considered "A", "B", and "C" from left to right, top to bottom or front to back when facing equipment.

F. Control and signal wiring shall not use the above named colors except Green for grounding. Any other colors or striping may be used, but the coding shall provide same color or striping between any two terminals being jointed.

G. "Travelers" in switching circuits shall be of the same color as phase conductors serving the circuit.

3.8 TESTING AND REPORTS: Prior to energizing, feeders, sub-feeders, and service conductor cables shall be tested for electrical continuity and short circuits. A copy of these tests shall be sent to the Owner.

END OF SECTION 16120

SECTION 16130 - CONDUIT AND BOXES

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Rigid metal conduit and fittings.

B. Electrical metallic tubing and fittings.

C. Liquidtight flexible metal conduit and fittings.

D. Schedule 40 rigid PVC conduit and fittings.

E. Wall and ceiling outlet boxes.

F. Pull and junction boxes.

1.2 RELATED WORK:

A. Cutting and Patching - Section 01045.

B. Trenching: Excavation and backfill for conduit and utilities on site - Section 02225.

C. Cast-In-Place Concrete: Protective envelope for underground conduit installations - Section 03300.

D. Sheet Metal Flashing and Trim - Section 07620.

E. Wiring Devices - Section 16140.

1.3 REFERENCES:

A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.

B. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated.

C. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.

D. FS WW-C-563 - Electrical Metallic Tubing.

E. FS WW-C-566 - Specification for Flexible Metal Conduit.

F. FS WW-C-581 - Specification for Galvanized Rigid Conduit.

G. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

H. ANSI/NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.

I. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

PART 2 - PRODUCTS

2.1 RIGID METAL CONDUIT AND FITTINGS:

A. Rigid Steel Conduit: ANSI C80.1., FS WW-C-581.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; threaded type, material to match conduit.

2.2 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS:

A. EMT: ANSI C80.3., FS WW-C-563. galvanized tubing.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel, compression type.

2.3 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS:

A. Conduit: Flexible metal conduit with PVC jacket.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1.

2.4 PLASTIC CONDUIT AND FITTINGS:

A. Conduit: NEMA TC 2; Schedule 40 PVC.

B. Fittings and Conduit Bodies: NEMA TC 3.

2.5 CONDUIT SUPPORTS:

A. Conduit Clamps, Straps, and Supports: Steel or malleable iron.

B. Galvanized for moist locations. Hot dip galvanized for exposure to weather. Non-metal in corrosive areas.

2.6 ACCEPTABLE CONDUIT MANUFACTURERS:

A. Allied

B. Triangle

C. Wheatland

2.7 OUTLET BOXES:

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1; galvanized steel.

B. Cast Boxes: Cast malleable iron, gasketed cover, threaded hubs.

C. Acceptable Manufacturers: Appleton, Crouse-Hinds, Steel-City.

2.8 PULL AND JUNCTION BOXES:

A. Sheet Metal Boxes: ANSI/NEMA OS 1; galvanized steel.

B. Sheet Metal Boxes Larger Than 12 Inches in Any Dimension: Hinged enclosure.

C. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Cast aluminum box and cover with ground flange, neoprene gasket, and stainless steel coverscrews.

D. Acceptable Manufacturers: Appleton, Crouse-Hinds, Steel-City.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT, AND SUPPORT:

A. Size conduit for conductor type installed; 3/4" minimum size. Minimum size liquidtight conduit is 3/4".

B. Arrange conduit to maintain headroom and present a neat appearance.

C. Route exposed conduit and conduit above accessible ceilings parallel and perpendicular to walls and adjacent piping.

D. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

E. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit using galvanized straps, lay-in adjustable hangers, clevis hangers, or bolted split stamped galvanized hangers.

F. Group conduit in parallel runs where practical and use conduit rack constructed of steel channel with conduit straps or clamps. Provide space for 25 percent additional conduit.

G. Do not fasten conduit with wire or perforated pipe straps. Remove all wire used for temporary conduit support during construction, before conductors are pulled.

H. Support conduit at a maximum of 7 feet on center, unless otherwise noted or indicated on the Drawings.

3.2 CONDUIT INSTALLATION:

A. Cut conduit square using a saw or pipecutter; de-burr cut ends.

B. Bring conduit to the shoulder of fittings and couplings and fasten securely.

C. Use conduit hubs or sealing locknuts for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations.

D. Install no more than the equivalent of three 90 degree bends between boxes.

E. Use conduit bodies to make sharp changes in direction, as around beams.

F. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.

G. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.

H. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.

I. Provide No. 10 AWG insulated conductor or suitable pull string in empty conduit, except sleeves and nipples.

J. Install expansion joints where conduit crosses building expansion joints.

K. All conduit bodies to be malleable iron, with weather-proof coating, neoprene gasket and malleable iron cover.

L. Route conduit through roof openings for piping and ductwork where possible; otherwise, route through roof jack with pitch pocket.

M. Use asphalt-coated rigid steel factory elbows for all bends in plastic conduit.

N. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.

O. Use compression-type steel fittings with EMT.

3.3 CONDUIT INSTALLATION SCHEDULE:

A. Concealed Dry Interior Locations:

1. Branch circuit conduit shall be electrical metallic tubing.

B. Connections to Movable or Vibrating Equipment: Provide a minimum of 2 ft. of liquidtight flexible conduit in each connection to transformers, motors, and other equipment which may be moved for maintenance. Provide a minimum of 2 ft. of flexible steel conduit in all connections to recessed fixtures and equipment in suspended ceilings.

3.4 SLEEVES AND PENETRATIONS:

A. Contractor shall provide sleeves and openings for raceways penetrating exterior wall, interior walls and partitions, floors, and roofs. Provisions for all such penetrations shall be as approved by the Owner.

B. For any raceway passing through an exterior wall, above or below grade, provide appropriate sleeve and waterproofing.

C. Route conduits penetrating roof through openings for piping and ductwork, where feasible. Otherwise, route through roof jacks with pitch pockets.

D. For raceways penetrating non-fire-rated interior walls or partitions, provide steel pipe sleeves with flush fit and mortared-in or plastered-in, as required.

E. Penetrations through fire-rated walls, floors, and ceilings shall not diminish the fire rating and shall meet ASTM 814, UL, and NEC requirements.

3.5 COORDINATION OF BOX LOCATIONS:

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.

B. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.

C. Locate and install boxes to allow access. Where installation is inaccessible, coordinate locations and sizes of required access doors with Owner.

D. Locate and install to maintain headroom and to present a neat appearance.

3.6 OUTLET BOX INSTALLATION:

A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24 inch separation in acoustic-rated walls.

B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.

C. Provide knockout closures for unused openings.

D. Support boxes independently of conduit except for cast boxes that is connected to two rigid metal conduits, both supported within 12 inches of box.

E. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.

F. Install boxes in walls without damaging wall insulation.

G. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

H. Position outlets to locate luminaires as shown on reflected ceiling plans.

I. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.

J. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

K. Align wall-mounted outlet boxes for switches, thermostats, and similar devices.

L. Provide cast outlet boxes in exterior locations and wet locations.

3.7 PULL AND JUNCTION BOX INSTALLATION:

A. Provide and install all boxes in accordance with the requirements of Articles 370, 373, and 501 of the National Electric Code.

B. Install pull and junction boxes where indicated on Drawings. In addition, install pull boxes per the following for above grade conduit runs:

1. Install pull boxes in each conduit run such that the total of all bends including offsets does not exceed 360^{o}.

2. Install pull boxes in conduit runs containing wire sizes #1 AWG or smaller at intervals not exceeding 100 ft.
3. Install pull boxes in conduit runs containing wire sizes #1/0 AWG and larger at intervals not exceeding 200 ft.

C. Provide pull and junction box sizes as indicated on Drawings. Where sizes are not indicated on Drawings, size boxes for 600V or less wiring in accordance with Article 314-28 of the NEC and the following table.

TABLE FOR STANDARD PULL BOX SIZE FOR STRAIGHT PULL (600V)

Conduit Size	Box Size		
	Length	Width	Depth
1-1/2"	18"	4"	4"
2"	24"	6"	6"
2-1/2"	30"	6"	6"
3"	36"	6"	6"
3-1/2"	42"	8"	8"
4"	48"	10"	10"

TABLE FOR STANDARD PULL BOX SIZE FOR ANGLE PULL (600V)

Conduit Size	Box Size		
	Length	Width	Depth
1-1/2"	18"	18"	4"
2"	24"	24"	6"
2-1/2"	30"	30"	6"
3"	32"	32"	6"
4"	36"	36"	10"

D. Rigidly support all boxes directly from ceiling or walls or via hangers.

END OF SECTION 16130

SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Wall switches.

B. Receptacles.

C. Device plates and box covers.

1.2 REFERENCES:

A. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet.

B. FS W-S-896 - Switch, Toggle.

C. NEMA WD 1 - Specification-Grade Wiring Devices.

D. NEMA WD 5 - Specific-Purpose Wiring Devices.

1.3 SUBMITTALS:

A. Submit product data under provisions of Section 01300.

B. Provide product data showing configurations, finishes, dimensions, and manufacturer's instructions.

PART 2 - PRODUCTS

2.1 GENERAL DESIGN: Wiring devices shall be of the grounding type, with hex-head grounding screw, to be connected to the green ground conductor.

2.2 ACCEPTABLE MANUFACTURERS - WALL SWITCHES:

A. Hubbell

B. Leviton

C. Pass & Seymour

D. Substitutions: Under provisions of Section 01600.

2.3 WALL SWITCHES:

A. Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: NEMA WD; 1 FS W-S-896; AC general use snap switch with toggle handle, rated 20 amperes and 120-277 volts AC. Handle: Ivory.

B. Wall switches shall be of the grounding type, with hex head grounding screw to be connected to the green grounding conductor.

C. Pilot Light Type: Pilot strap in adjacent gang.

D. Locator Type: Lighted handle.

2.4 ACCEPTABLE MANUFACTURERS - RECEPTACLES:

A. Hubbell

B. Leviton

C. Pass & Seymour

D. Substitutions: Under provisions of Section 01600.

2.5 RECEPTACLES:

A. Convenience and Straight-blade Receptacles: NEMA WD 1, FS W-C-596, 20A, 120V.

B. Locking-Blade Receptacles: NEMA WD 5.

C. Convenience Receptacle Configuration: NEMA WD 1; Type 5-20 R, ivory, 20A, 120V.

D. Specific-use Receptacle Configuration: NEMA WD 1 or WD 5; type as indicated on Drawings, ivory.

E. GFCI Receptacles: Duplex convenience receptacle with integral ground fault current interrupter, 20A, 120V.

F. Receptacles shall be of the grounding type, with hex head grounding screw to be connected to the green grounding conductor.

2.6 ACCEPTABLE MANUFACTURERS - WALL PLATES:

A. Leviton

B. Crouse-Hinds

C. Hubbell

D. Pass & Seymour

E. Arrow-Hart

F. Substitutions: Under provisions of Section 01600.

2.7 WALL PLATES:

A. Decorative Cover Plate: Smooth stainless steel.

B. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device in use covers.

PART 3 - EXECUTION

Not Used.

END OF SECTION 16140

SECTION 16410 - DISCONNECT SWITCHES AND FUSING

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Furnish and install disconnect switches as shown or indicated on the Drawings.

B. Furnish and install fuses in all fusible disconnect switches in accordance with the Drawings and these Specifications.

1.2 REFERENCES:

A. ANSI/UL 198C - High-Intensity Capacity Fuses; Current Limiting Types.

B. ANSI/UL 198E - Class R Fuses.

C. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).

D. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.

E. NEMA KS 1 - Enclosed Switches.

1.3 SUBMITTALS:

A. Submit product data under provisions of Sections 01300 and 16010.

B. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - DISCONNECT SWITCHES:

A. Square D Company, General Electric, Westinghouse.

B. Substitutions: Under provisions of Section 01600 and 16010.

2.2 DISCONNECT SWITCHES:

A. Fusible Switch Assemblies: Heavy-duty type, NEMA KS 1; FS W-S-865; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F- 870. Designed to accommodate Class R fuses.

B. Nonfusible Switch Assemblies: NEMA KS 1; Type HD; GD; FS W-S-865; quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.

C. Enclosures: NEMA KS 1; Type as indicated on Drawings.

2.3 ACCEPTABLE MANUFACTURERS - FUSES:

A. Buss Fuse Company, Gould Shawmut.

B. Substitutions: Under provisions of Sections 01600 and 16010.

2.4 FUSES:

A. Fuses rated 600 Amperes or less shall be UL Class RK1 or RK5, in accordance with the Disconnect Schedule on the Drawings.

B. All fuses shall have a 60 cycle interrupting rating of 200,000 RMS Amperes at their rated voltage, and shall be current limiting.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install disconnect switches where indicated on Drawings.

B. Install fuses in fusible disconnect switches.

3.2 DISCONNECT SWITCH SCHEDULE: As shown on the Drawings.

3.3 SPARE FUSES: Provide Owner with minimum of three (3) fuses of each type and rating.

END OF SECTION 16410

SECTION 16440 - PANELBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Distribution panelboards.

B. Lighting and appliance branch circuit panelboards.

1.2 REFERENCES:

A. FS W-C-375 - Circuit Breakers, Molded Case, Branch Circuit and Service.

B. FS W-P-115 - Power Distribution Panel.

C. NEMA AB 1 - Molded Case Circuit Breakers.

D. NEMA PB 1 - Panelboards.

E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.3 SUBMITTALS:

A. Submit shop drawings for equipment and component devices under provisions of Sections 01300 and 16010.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.4 SPARE PARTS: Keys: Furnish four each to Owner.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES - PANELBOARDS:

A. Square D Company, General Electric, Cutler Hammer, Siemens.

B. Substitutions: Under provisions of Sections 01600 and 16010.

2.2 DISTRIBUTION PANELBOARDS:

A. Panelboards: NEMA PB 1; circuit breaker type.

B. Enclosure: NEMA PB 1; Type 1. Cabinet size: As per equipment manufacturer.

C. Provide cabinet front with concealed trim clamps, screw cover, and hinged door with flush lock. Finish in manufacturer's standard gray enamel.

D. Provide panelboards with copper bus, ratings as scheduled on Drawings. Provide copper ground bus in all panelboards.

E. Minimum Integrated Short Circuit Rating: As shown on Drawings. “Full Rating Only.” Cascading system not acceptable.

F. Molded Case Circuit Breakers: NEMA AB 1 FS W-C-375; provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

2.3 BRANCH CIRCUIT PANELBOARDS:

A. Lighting and Appliance Branch Circuit Panelboards: NEMA PB1; circuit breaker type. FS

W-P-115; Type I, Class 1.

B. Enclosure: NEMA PB 1; Type 1.

C. Provide flush or surface cabinet front with concealed trim clamps as indicated on the Drawings, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

D. Provide panelboards with copper bus, ratings as scheduled on Drawings. Provide copper ground bus in all panelboards.

E. Minimum Integrated Short Circuit Rating: As shown on Drawings.

F. Molded Case Circuit Breakers: NEMA AB 1 FS W-C-375; bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on Drawings. Provide UL Class A arc fault interrupter circuit breaker for all branch circuits serving sleeping quarters.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install panelboards plumb and where recessed mounted, install flush with wall finishes, in conformance with NEMA PB 1.1. For surface mounted panelboards, support from building members, independent of all finished surfaces and conduits.

B. Height: 6 ft. to top of panelboard from finished floor.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

E. Stub 5 empty one inch conduits to accessible location above ceiling out of each recessed panelboard.

3.2 FIELD QUALITY CONTROL:

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

3.3 PANELBOARD SCHEDULE: Panelboard types and ratings as indicated or scheduled on the Drawings.

END OF SECTION 16440

SECTION 16500 - LIGHTING

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Provide complete, working lighting systems, as shown or indicated on the Drawings and as described in these Specifications.

B. Provide new lamps for all lighting fixtures at time of Owner's acceptance.

C. Provide supports, pole bases, cords, fittings and all accessories necessary for complete working systems and as shown or indicated on the Drawings and as described in these Specifications.

1.2 REFERENCES:

A. ANSI C82.1 - Specification for Fluorescent Lamp Ballasts.

B. ANSI C82.4 - Specification for High-Intensity-Discharge Lamp Ballasts (Multiple Supply Type).

C. FS W-F-414 - Fixture, Lighting (Fluorescent, Alternating-Current).

1.3 SUBMITTALS:

A. Submit product data under provisions of Sections 01300 and 16010.

B. Include outline drawings, lamp and ballast data, support points, weights, and accessory information for each luminaire type.

C. Submit manufacturer's installation instructions under provisions of Section 01300.

1.4 DELIVERY, STORAGE, AND HANDLING:

A. Deliver products to site under provisions of Sections 01600 and 16010.

B. Store and protect products under provision of Section 01600.

PART 2 - PRODUCTS

2.1 FLUORESCENT LUMINAIRES AND ACCESSORIES:

A. Fluorescent luminaires shall be provided with ballasts meeting the following criteria:

1. Ballast to be "UL Listed, Class P", unless otherwise noted on the Drawings.
2. Ballast to be "Sound Rated A".
3. Ballast to be electronic, unless otherwise noted on the Drawings.
4. Ballasts containing PCB's are not acceptable.
5. Ballast enclosure size shall be same as, or smaller than, magnetic ballast.
6. Light regulation shall be + 10% input voltage variation.
7. Ballast shall have high power factor (minimum of 90%).
8. Lamp current crest factor shall be equal to, or less than, 1.7.
9. Input current third harmonics shall not exceed ANSI recommendations.

10. Flicker shall be 15% or less with any lamp suitable for the ballast.

11. Ballasts shall withstand line transients per IEEE 587, Category A.

12. Ballast case temperature shall not exceed 25^{o}C rise over 40^{o}C ambient.

13. Ballast shall meet FCC Rules and Regulations, Part 18.

2.2 ACCEPTABLE MANUFACTURERS - BALLASTS:

A. G.E.

B. Advance

C. Universal

2.3 ACCEPTABLE MANUFACTURERS - LAMPS:

A. Sylvania, G.E., Philips.

B. Substitutions: Under provisions of Section 01600.

2.4 ACCEPTABLE MANUFACTURERS - LUMINAIRES:

A. As noted on Schedule.

B. Substitutions: Under provisions of Sections 01600 and 16010.

2.5 LAMPS: Fluorescent Lamps: Type T8 lamps, 3500^{o}K, unless otherwise scheduled on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install lamps in luminaires and lampholders.

B. Where a recessed fluorescent or downlight fixture replaces a section or part of a ceiling tile, fixture is to be supported at all two (2) corners to the steel frame of the building. Supports shall be provided with the same type of wire as used to support the lay-in ceiling track. Attach one end of the wire to one corner of the fixture and the other end to the building's structural system.

C. Install recessed luminaires to permit removal from below. Use plaster frames. Install grid clips.

3.2 RELAMPING: All lamps are to be new at time of Owner's acceptance.

3.3 ADJUSTING AND CLEANING:

A. Align luminaires and clean lenses and diffusers at completion of Work. Clean paint splatters, dirt, and debris from installed luminaires.

B. Touch up luminaire finish at completion of work.

3.4 LUMINAIRE SCHEDULE: As shown and as indicated on the Drawings, and as described in these Specifications.

END OF SECTION 16500